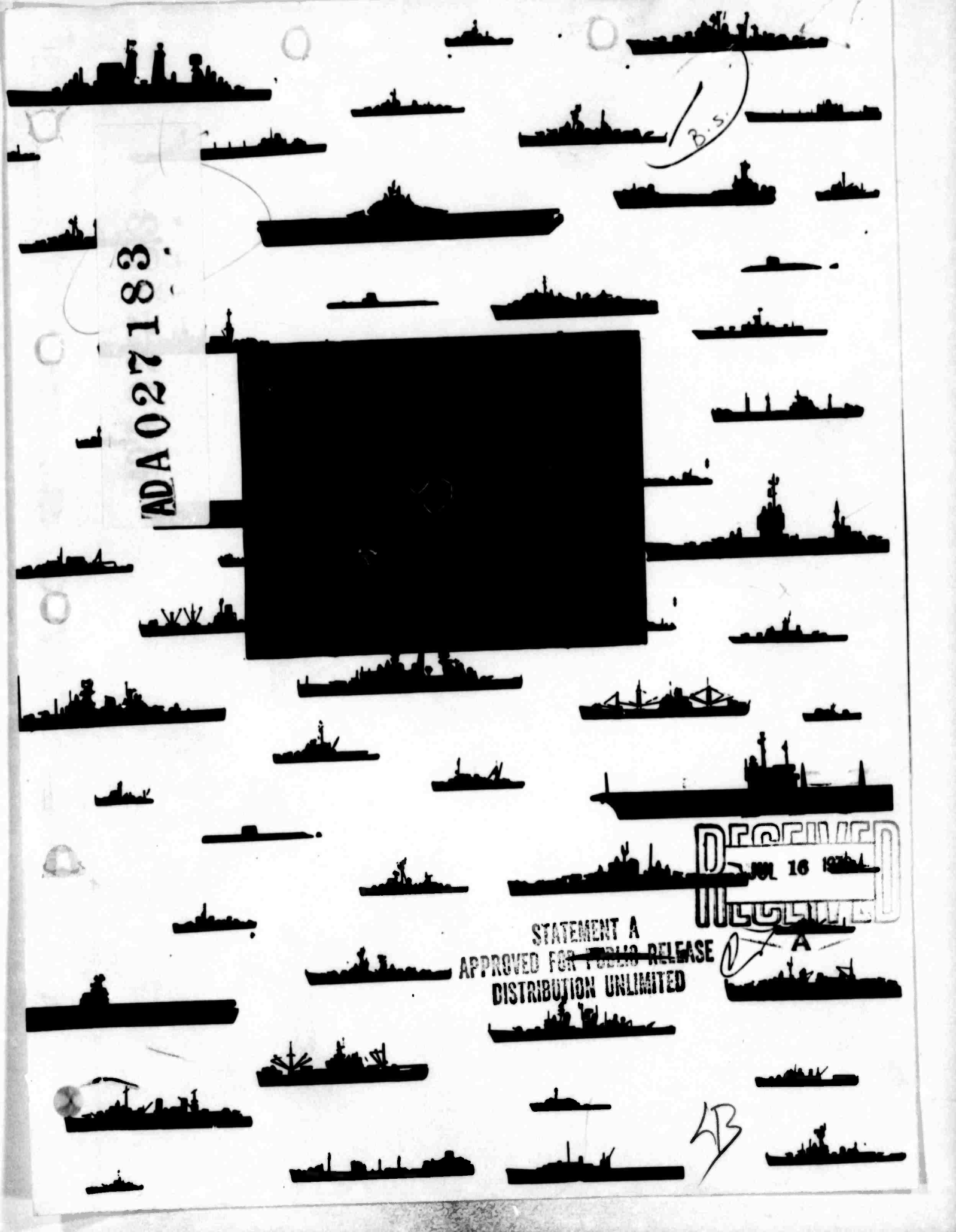
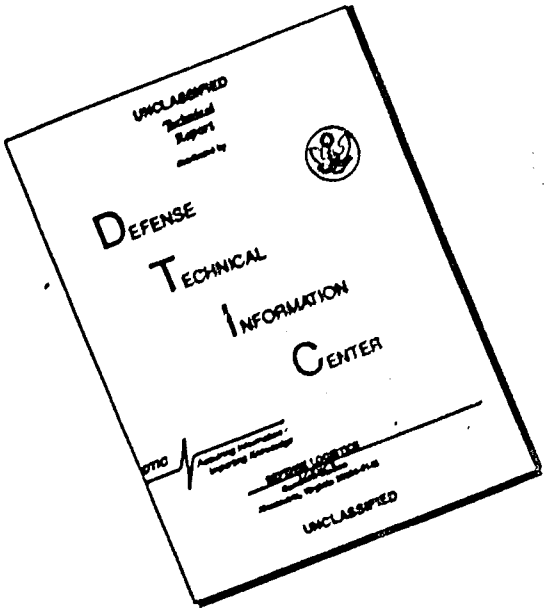


DISCLAIMER NOTICE



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NAVAL SHIP ENGINEERING CENTER Hyattsville

HULL MECHANICAL & WEAPONS SYSTEMS Dev

ASR - 21/22 FOUR POINT MOOR ANCHOR WINDLASS DESIGN REVIEW

1974 latest year

6162-74-4 NAV ship Sys Com

138 p.

BY

R.D. JAMIESON, SEC 6162E
J.C. SANDISON, SEC 6162E
M. [redacted] K, SEC 6164B

M. Bartoszyk

IN RESPONSE TO:
ACTION MESSAGE 301432Z
ETA 36018 of 28 APR 74 (NAVSEC CONTROL 4119005)
ETA 36025 of 8 AUG 74 (NAVSEC CONTROL 4224001)

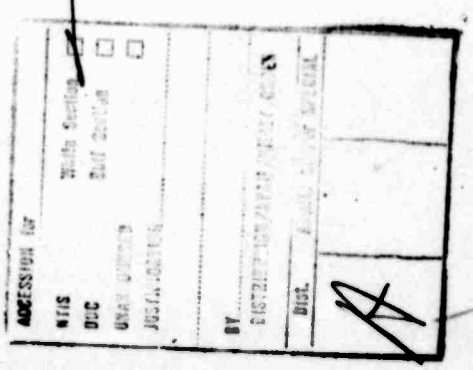
BY

PMS 383

Signature _____
Head, Shipboard Ocean Engineering, Section 6162E

Signature _____
Head, Unrep and Ship Control, Section 6164B

INDEX



LIST OF FIGURES

NAVSEC 0/* (REV. 8-73) NAVSEC LOG DATE

ENGINEERING TASK AUTHORIZATION

4113005

FROM:	NAME: (Originator) (Extension)	CHARGE JOB ORDER NO.	ORIGINATOR'S SERIAL NO.
PMS383D	CDR R. Christensen 692-3517	837E200	36018
TO: SEC 6162	NAME: (Optional) Robert Jamieson	PRIORITY: * R ☐ U ☒ E ☐	REQUESTED COMPLETION DATE 3 MAY 1974
VIA: SEC 6106A22	TITLE: ASR 21/22 Mooring System Deficiencies		SWAPS DESIGNATOR

ENCL: (1) ORTOLAN Casrpt msg 220400Z Apr 74
(2) Two photos of ASR-22 Focsle Area

TASK DESCRIPTION:

The USS ORTOLAN has experienced (1) a problem on the forward two mooring buoys with a slippage of the chain around the wildcat when walking out the anchor and (2) with marginal wildcat capacity (hydraulic power unit) to lift 1000' moor when ship experiencing surging seas. Request NAVSEC investigate and provide recommended corrective action.

List of applicable drawings AND PHOTO'S to be provided by separate correspondence.

1 45 PM '74

RESPONSE REQUESTED:	REPORTS REQUIRED	
☐ OFFICIAL LETTER ☒ NAVSEC TECH. MEMO ☐ OTHER	☒ TRAVEL ☐ OTHER	☐ CONSIDER USE OF CASREPT/MDCS DATA IN PERFORMING TASK, IF APPROPRIATE

ORIGINATOR'S MANDAY EST.	TRAVEL AUTHORIZED	ORIGINATOR'S AUTHORIZATION SIGNATURE	DATE
20	☒ YES ☐ NO	Robert Christensen	4/24/74

(Blocks below for NAVSEC use)

TECHNICAL CODE	DATE REC'D	DATE COMPL'D	RESPONSE SERIAL	TECHNICAL CODE SIGNATURE
6169B	5/19/74	11/22/74	SEA 6163-376	M. Bonfiglio

ACTION ADDRESSEE SIGNATURE	DATE	SINGLE POINT OF CONTACT SIGNATURE	DATE

PRIORITY CRITERIA

R = (ROUTINE) Give originator revised date in ETA Status Report if completion date cannot be met.

U = (URGENT) Complete before any of originator's routine tasks. If completion date cannot be met, inform originator.

E = (EMERGENCY) Completion date must be met. Contact originator upon receipt if there is any problem.

D-10501

* U.S. GOVERNMENT PRINTING OFFICE : 1973-727-464/992 3-1

(2)

NAVSEC LOG DATE

ENGINEERING TASK AUTHORIZATION

URGENT

4224001

FROM:	NAME: (Originator) (Extension)	CHARGE JOB ORDER NO.	ORIGINATOR'S SERIAL NO.
MS383D	CDR R. CHRISTENSEN 23517	837E200	36025
TO:	**NAME: (Optional)**	**PRIORITY:**	**REQUESTED COMPLETION DATE**
SEC 6164	M. BARTOSZYK	R ☐ U ☒ E ☐	9/13/74
VIA:	**TITLE:**		**SWAPS DESIGNATOR**
SEC 6106A22	ASR 21/22 MOORING SYSTEM DEFICIENCIES		

SUBJ: REF (a) NAVSEA ETA# 36018 DATED 4/24/74
ASR 21/22 MOORING SYSTEM DEFICIENCIES

TASK DESCRIPTION:

1. IN CONJUNCTION WITH AND AS A CONTINUATION OF REFERENCE (a), NAVSEC IS REQUESTED TO CONTINUE THE INVESTIGATION OF THE PROBLEMS ASSOCIATED WITH THE ASR 21/22 MOORING AND ANCHOR HANDLING SYSTEM. THE INVESTIGATION SHALL INCLUDE THE USE OF SKAGIT STEEL AND IRON WORKS PERSONNEL, THE MANUFACTURERS OF THE INSTALLED ANCHOR WINDLASS MACHINERY.

RESPONSE REQUESTED:		REPORTS REQUIRED	
☐ OFFICIAL LETTER ☒ NAVSEC TECH. MEMO ☐ OTHER		☒ TRAVEL ☐ OTHER	
ORIGINATOR'S MANDAY EST.	TRAVEL AUTHORIZED	ORIGINATOR'S AUTHORIZATION SIGNATURE	DATE
20MD.	☒ YES ☐ NO	R Christensen	8/8/74

(Blocks below for NAVSEC use)

TECHNICAL CODE	DATE REC'D	DATE COMPL'D	RESPONSE SERIAL	TECHNICAL CODE SIGNATURE
6164B	8/12/74	11/22/74	SEA 6163-375	M. Bartoszyk

ACTION ADDRESSEE SIGNATURE	DATE	SINGLE POINT OF CONTACT SIGNATURE	DATE

PRIORITY CRITERIA

R = *(ROUTINE) Give originator revised date in ETA Status Report if completion date cannot be met.*

U = *(URGENT) Complete before any of originator's routine tasks. If completion date cannot be met, inform originator.*

E = *(EMERGENCY) Completion date must be met. Contact originator upon receipt if there is any problem.*

D-12501

*** R E C A L L E D ***

*******U N C L A S E F T O*******

PRIORITY
P 3014322 AUG 74
FM COMNAVSEASYSCOM WASHINGTON DC

TO NAVSEC HYATTSVILLE MD
USS PIGEON

NAVSHIPYD PHILADELPHIA PA

INFO COMSUBLANT NORFOLK VA
COMSUBPAC PEARL HARBOR HI
NAVSHIPYD LONG BEACH CA

COMSUBRON SIX
COMSUBDEVGRUONE SAN DIEGO CA
SKAGIT CORPORATION
SEDRO-WOOLLEY, WASHINGTON

UNCLAS E F T O //N09260//

NAVSEC PASS TO CODES 6162E AND 6164B
ASR 21/22 FOUR POINT MOORING SYSTEM
A. NAVSEA 261917Z AUG 74.
B. ASR 21/22 SHIP SPEC PARA 9260-1-B.
C. ORTOLAN 011415Z AUG 74.

1. A MEETING OF PMS383, NAVSEC AND SKAGIT CORP. (WINDLASS MFG) REPS WAS CONDUCTED 27 AUG 74 AS INDICATED IN REF (A). THE BASIC PROBLEM ADDRESSED WAS THE NEED TO INSURE THE ABILITY OF THE WINDLASS SYSTEM TO PERFORM AS INTENDED DURING EXTENDED RETRIEVAL OPERATIONS OF A DEEP MOOR. A REVIEW OF THE SYSTEM AND THE PROBLEMS ENCOUNTERED TO DATE INDICATES THAT THEY CAN BE OVERCOME BY UPGRADING PERFORMANCE OF EXISTING SYSTEM.

2. A REVIEW OF THE DESIGN CALCULATIONS AND PREVIOUS TEST RESULTS INDICATES THAT SYSTEM HAS THE BASIC ABILITY TO LIFT THE 5000 LB LWT MOORING ANCHOR AND 200 FATHOMS OF CHAIN (TOTAL WEIGHT 35,630

SEASYS PMS383D(1)...ORG
RELEASER PMS383(1) SEA 944(1) 09G35(1) 383A4S(1) 383D(1)
383M(1) 383(1) U 008

SEC 6164E(1)...ACT
SECCOMM(1) 6162(1) 6141B(1) 6131(1) 6231(1) 6140E(1) 0358 R 007

TOTAL COPIES ... 015 ...

RECALLED/

255170/242 1 OF 3 ATT 7413 242/17:08Z

*******U N C L A S E F T O*******

LB AT 24 FT PER MINUTE AS REQUIRED BY REF (B). THIS IS CONSIDERED [illegible]

[illegible] THE TROUBLE OF OVERHEATING OF HYDRAULIC SYSTEM EXPERIENCED DURING THE RETRIEVAL OPERATION IS ATTRIBUTED TO PREMATURE LIFTING OF THE HYDRAULIC RELIEF VALVE (INTERNAL RELIEF RESULTS IN RAPID INCREASE IN OIL TEMP.), AND INSUFFICIENT COOLING OF HYDRAULIC OIL SYSTEM. ADDITIONALLY, THE DUTY CYCLE OF THE ELECTRIC DRIVE MOTOR IS CONSIDERED MARGINAL. THE PROBLEM IS COMPOUNDED BY POSSIBLE OVERLOADING OF SYSTEM UNDER SUSTAINED ADVERSE SEA/WIND/CURRENT CONDITIONS AND/OR A CATENARY WHICH RESULTS IN THE WINDLASS BEING REQUIRED TO LIFT IN EXCESS OF ITS RATED LOAD OVER AN EXTENDED PERIOD OF TIME. DURING TESTS CONDUCTED ON ORTOLAN ON OR 28 JULY UNDER SEA STATE ONE CONDITIONS, PROBLEMS WITH OVERHEATING OR INSUFFICIENT WINDLASS TORQUE WERE NOT ENCOUNTERED. REF (C) REFERS. UPCOMING TESTS ON PIGEON WILL PROVIDE ADDITIONAL DATA.

3. REVIEW OF INSTALLED SYSTEM COMPONENTS INDICATES THAT CERTAIN STEPS CAN BE TAKEN TO UPGRADE THE SYSTEM'S OVERALL PERFORMANCE. TO THIS END, THE FOLLOWING AGREED UPON ACTION IS REQUIRED:

(A) FOR NAVSEC:

1. ESTABLISH STATIC AND DYNAMIC MOORING LOADS UNDER VARYING CONDITIONS OF DEPTH, WIND, AND CURRENT AT SEA STATES THREE AND BELOW. DEVELOP CURVES OF CHAIN CATENARY AND ASSOCIATED WEIGHT OF FREE HANGING CHAIN.

2. INVESTIGATE AND RECOMMEND SPECIFIC MODS REQUIRED TO UPGRADE SYSTEM PERFORMANCE. AS A MINIMUM SYSTEM OPERATING PRESSURE NEEDS TO BE INCREASED, MEANS OF EXTENDING DUTY CYCLE OF MOTOR SHOULD BE CONSIDERED, AND A HYDRAULIC COOLER SHOULD BE INSTALLED.

3. ESTABLISH INCREASED SYSTEM CAPABILITY TO BE ACHIEVED UPON INSTALLATION OF RECOMMENDED MODS.

4. UPDATE TECH MANUALS AND PMS TO REFLECT MODS INCORPORATED INTO SYSTEM PLUS ADDITIONAL OPERATING PARAMETERS DEEMED NECESSARY.

5. EXECUTE CONTRACT WITH SKAGIT CORP. ON EMERGENCY BASIS TO OBTAIN REQUIRED TECHNICAL ASSISTANCE IN SUPPORT OF ABOVE TASKS.

6. ASSIST PMSV IN ESTABLISHING HAWSEPIPE/BOLSTER EFFICIENCY. OBSERVE AND EVALUATE TEST RESULTS.

7. ESTABLISH OPERATING PROCEDURES/LIMITATIONS DETERMINED TO BE REQUIRED WHEN CONDUCTING DEEP MOORS.

8. OBSERVE AT SEA TESTS OF WINDLASS ON USS PIGEON AND EVALUATE RESULTS. REF (A) REFERS.

(B) FOR PMSV:

1. DETERMINE HAWSEPIPE/BOLSTER EFFICIENCY.

2. OBSERVE AT SEA TESTS OF WINDLASS ON USS PIGEON AND EVALUATE RESULTS. ASSIST NAVSEC IN ANALYSIS.

3. INCORPORATE REQUIRED FIXES ON ORTOLAN AND TEST SYSTEM DURING RAV SEA TRIAL IN 1000 FT OF WATER USING FULL SCOPE OF CHAIN.

(C) FOR NAVSEC/PNSY:

1. PROVIDE [illegible] (CODE 216) WITH NECESSARY DOCUMENTATION TO PERMIT INCORPORATION OF REQUIRED MODS ON PIGEON. THOSE ACTIONS LISTED ABOVE WHICH ARE REQUIRED TO SUPPORT ACCOMPLISHMENT OF ACTUAL CHANGES TO EQUIPMENT ON ORTOLAN ARE TO BE COMPLETED ASAP AND NLT 1 OCT 1974.

4. FOR USS PIGEON, REQUEST SHIP ADVISE CDR CHRISTENSEN, NAVSEA PMS383, TEL. AUTOVON 222-3513, MR. R. JAMIESON, NAVSEC CODE 61623, TEL. AUTOVON 296-1156, AND MR. ED DRAGUN, PNSY CODE 216, TEL. AUTOVON 443-3809 WHEN PIGEON WILL CONDUCT AT SEA TESTS OF ANCHOR WINDLASS.

II INTRODUCTION:

By NAVSEA ETA's 36018 of 24 April 1974, 36025 of 8 August 1974 and action message 3014322, NAVSEC was requested to investigate and recommend alterations to correct the difficulties being experienced by the ASR's 21 and 22, USS PIGEON and ORTOLAN, during deep sea mooring operations. The difficulties being experienced by the ships were found to fall in the following categories:

a. Anchor chains jumps off wildcat during payout operation;

b. Electric motors overload and stall during anchor retrieving operations in 1000 foot of water;

c. Hydraulic components (pumps and motors) and fluid overheat;

d. Wildcat locking head dogs travel in their slots causing "hammering" on the anchor windlasses; and

e. Wildcat shafts bushings (bearings) damaged during operations.

The first step of the investigation by NAVSEC was to define the baseline for the anchor windlass system and its problems. The problems were as follows:

1. Anchor Windlass Design

The anchor windlasses aboard USS PIGEON (ASR 21) and USS ORTOLAN (ASR 22) were designed by Skagit Corporation in accordance with the ASR 21/22 ships specification. Section 9260 of that document requires standard and deep sea anchoring systems. In the deep sea mooring application the anchor windlass must be capable of lowering and recovering 5,000 pound LWT anchor plus 200 fathoms of 1-1/2" diameter anchor chain at a speed of not less than 4 fathoms per minute. The windlass should be designed in accordance with Military Specification, MIL-w-19623, used in the purchasing of conventional electric-hydraulic windlasses. The specification was deficient by only specifying the duty of electric motor as: full load one hour; 1/4 load continuous; and also by not requiring a deep sea mooring testing. Therefore, it is believed that the manufacturer, Skagit, complied with the ships specifications in all areas.

2. Anchor Windlass - ORTOLAN

The anchor chain jumps off the forward port and starboard wildcats during payout operations. These abnormalities normally begin at the sixth to eighth shot of chain on the deck. According to ORTOLAN these abnormalities occur only when the forward (port or starboard) 5,000 pound anchors are used. It was concluded by

NAVSEC and NAVSHIPYD PHILA that the jumping of the anchor chain is due to insufficient wrap (approximately 115°) of the anchor chain on the wildcats. In normal anchor handling arrangements the anchor chain wrap of the wildcat is 180°. At the request of NAVSEA, NAVSHIPYD PHILA designed and NAVSHIPYD NORVA fabricated and installed aboard ORTOLAN a chain guide which increased the anchor chain wrap on the wildcat from 115° to 125°. Ship check shows however, that the chain guide as fabricated does not conform with the drawing requirements. As a further improvement on NAVSEC recommendation, ORTOLAN eliminated the anchor chain twist between the wildcat and the bitter end shackle in the chain locker and reoriented the detachable links into a horizontal position (links flat side is parallel to the deck when passing through the wildcat). With the above corrections, ORTOLAN subjected her forward windlasses to tests on 30 July 1974. Test results show that the starboard windlass could not be operated due to hammering of the traveling locking head dogs in their engagement slots. ORTOLAN's previous experience indicated that the wildcat shaft bushings were damaged. Therefore, the stb. windlass was disassembled and forwarded to NAVSHIPYD NORVA for inspection of the wildcat shaft bushings. The results of this inspection did not reveal any deficiency in the bushings. The port windlass performed staisfactorily with the exception of chain jumping the wildcat (22 times during 30 shots of anchor chain payout). The power plant of the port windlass operated satisfactorily at this time. There was no overheating of any components or overloading of the electric motor. The highest temperature recorded was 154°F on the hydraulic pump case, whereas temperature of hydraulic fluid was 115°F. The Navy's maximum permissible hydraulic fluid temperature is 180°F. The highest load recorded on the electric motor was 65 amps while rated full load operating amperage is 78.5 amps. The average speed of anchor chain recovery was about 5 fathom per minute. It should be noted that the above operation was not conducted at required sea state 3 but at calm sea (sea state 1). Based on the above data, it was concluded that further improvement of the chain guide will eliminate chain jumping off ~~from~~ wildcats.

3. Anchor Windlass - PIGEON

On 8 October 1974, PIGEON subjected her forward port windlass with the improved chain guide (anchor chain wrap on the wildcat about 140°) to a deep sea mooring test. The test was conducted in 1,000 feet depth of water and at sea state 1-1/2 - 2. The tests show that chain started to jump when the 13th shot reached the deck. A check of the anchor chain revealed that the width of all common links of the 13th shot measured 5-5/8" whereas NAVSEA Dwg. 805-2137659 specifies 5-3/8" $\pm$ 1/8". Thus, oversized chain caused the chain to jump in this situation. Performance of the windlass power plants was satisfactory. The highest oil temperature

recorded was 164°F and the highest amperage recorded for the electric motor was 68 amps. During this test, the chain guide and wildcat whelps were greased with graphite grease to improve the chain mating with the wildcat. The second test conducted by PIGEON on 17 October 1974 in 180 fathoms of water and sea state 1 (calm sea) revealed an oversized detachable link which precluded proper mating of the chain on the wildcat. The maximum hydraulic fluid temperature incurred was 159°F and the electric motor was momentarily overloaded by drawing 80 and 83 amps.

III Calculations of Existing System Requirements

1) Sea State Conditions

SEA STATE	SEA - GENERAL (DESCRIPTION)	WIND (DESCRIPTION)	WIND VELOCITY (FPS)	WIND VELOCITY (KNOTS)	WAVE HEIGHT (FT) (SIGNIFICANT)
0	SEA LIKE A MIRROR	CALM	0	0	0
1	SMALL WAVELETS, STILL SHORT BUT MORE PRONOUNCED: CRESTS HAVE A GLASSY APPEARANCE. BUT DO NOT BREAK.	GENTLE BREEZE	14.3	8.5	1.0
2	LARGE WAVELETS, CRESTS BEGIN TO BREAK. FOAM OF GLASSY APPEARANCE.		22.8	13.5	2.9
3	SMALL WAVES, BECOMING LARGER: FAIRLY FREQUENT WHITE HORSES.	MODERATE BREEZE	27.0	16.0	4.6
4	MODERATE WAVES, TAKING A MORE PRONOUNCED LONG FORM: MANY MORE WHITE HORSES ARE FORMED.	FRESH BREEZE	32.1	19.0	6.9

figure 1

2) Holding Power

The next step was to determine the holding power required for each sea state with wind and current both coming from 15° off the bow.

The wind force was taken from Hydrospace Research Corporation Report No. 141 "ASR Catamaran Mooring." By using Figure 3-1 a wind from 15° off the bow will have a resultant bearing which is then transferred to figure 2-2.

from figure 2 $\theta = 15^\circ$ $\alpha = 46^\circ$

from figure 3 $\alpha = 46^\circ$

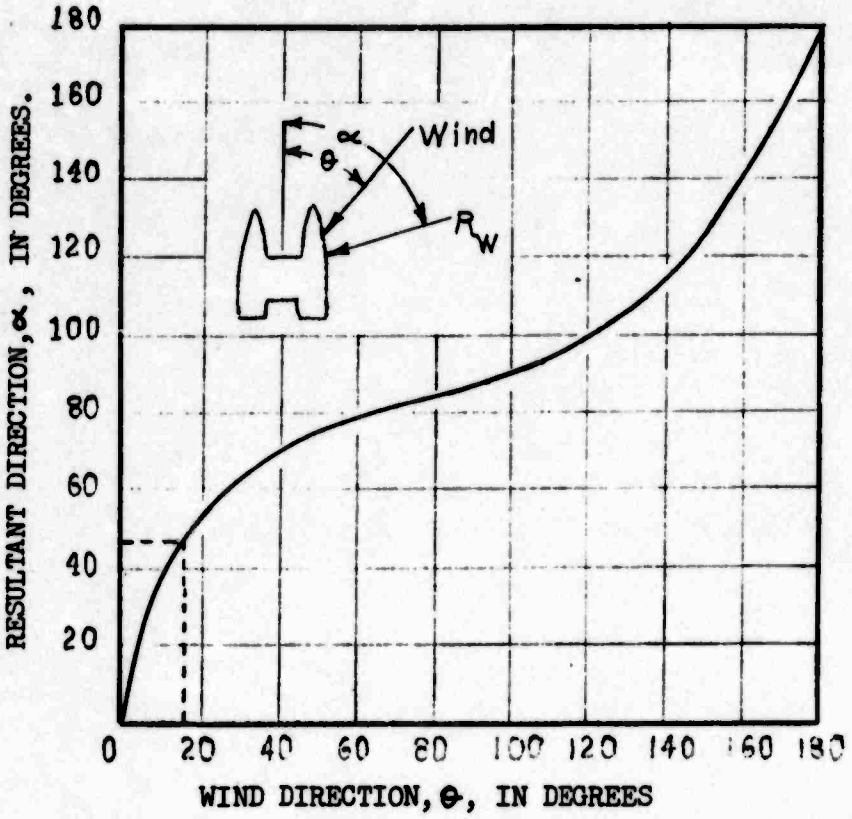
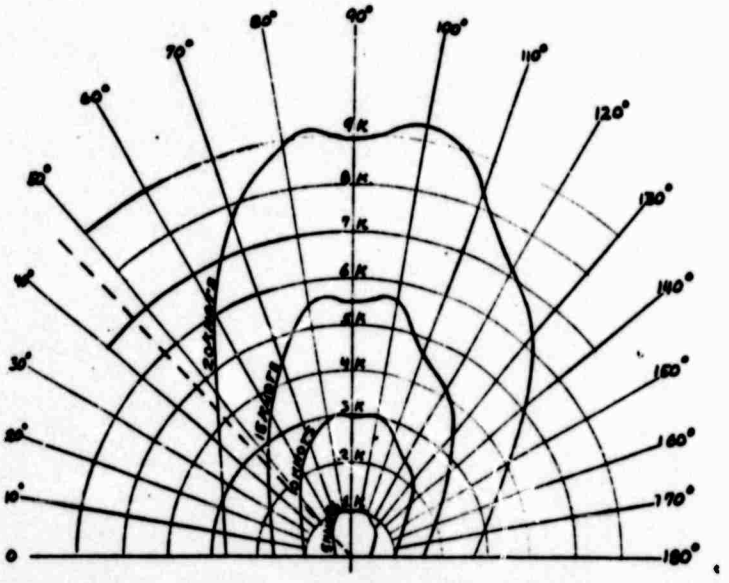


figure 2



WIND FORCE IN THOUSANDS OF POUNDS.
RESULTANT WIND FORCE AS A FUNCTION OF ANGLE, α, FOR VARIOUS WIND VELOCITIES.

figure 3

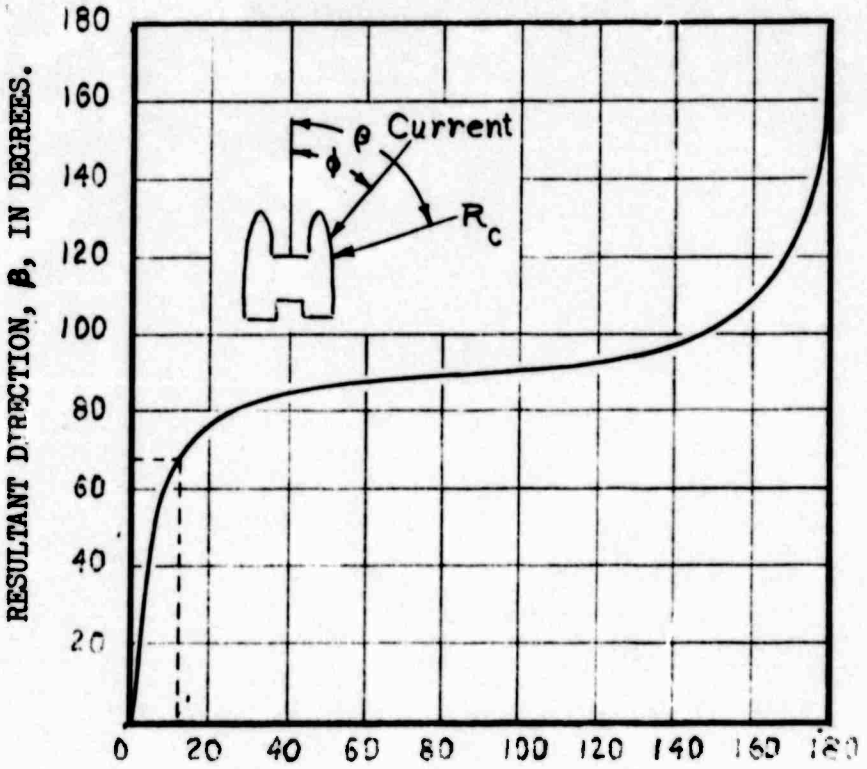
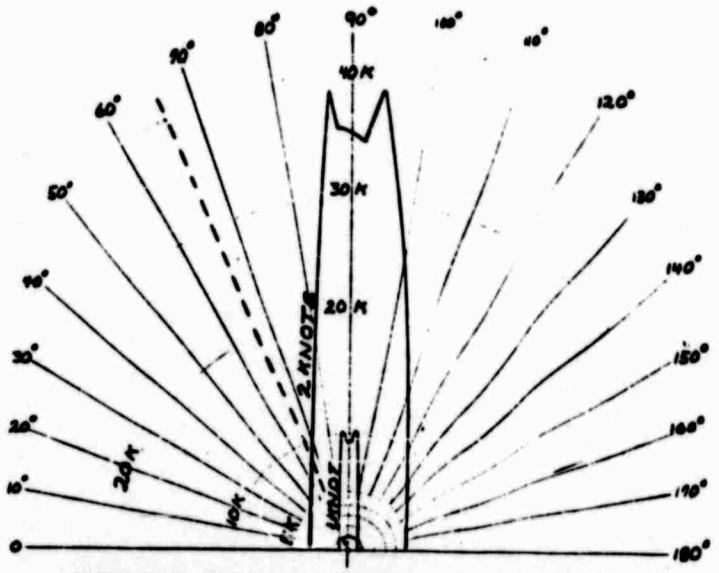


figure 4



CURRENT FORCE IN THOUSANDS OF POUNDS.
RESULTANT CURRENT FORCE AS A FUNCTION OF ANGLE, β, FOR VARIOUS CURRENT VELOCITIES.

figure 5

Sea State	Wind (Knots)	Force F_W (lbs.)
1	8.5	1,500
2	13.5	2,300
3	16.0	2,750
4	19.0	3,500

figure 6

The current force was also taken from Hydrospace Research Corporation Report No. 141. By using figure 4 a current from 15° off the bow will have a resultant bearing of 66° which is then transferred to figure 2-4.

from figure 4	Θ = 15°	β = 66°
from figure 5	β = 66° (1 knot)	F = 2,000 lbs.
from figure 5	β = 66° (2 knots)	F = 8,500 lbs.

A combining of the wind and current data generates the following resultant forces.

Sea State	Holding Power Required (lbs.)		
	Wind	Wind + 1 knot current	Wind + 2 knots Cur.
1	1500	3500	10,000
2	2500	4500	10,800
3	2750	4750	11,250
4	3500	5500	12,000

figure 7

These values represent the loads the ASR 21/22 could see while in a four point moor recovery mode for sea states 1 through 4, with currents ranging from 0-2 knots.

3. PLOT OF ANCHOR CHAIN CATENARIES

The figure below represents the computer printouts contained in Appendix A of this report. The weight of the anchor chain catenary generated by the various holding powers imposed on the ship will then be used to determine the lifting loads necessary for the recovery of the chain in various sea states.

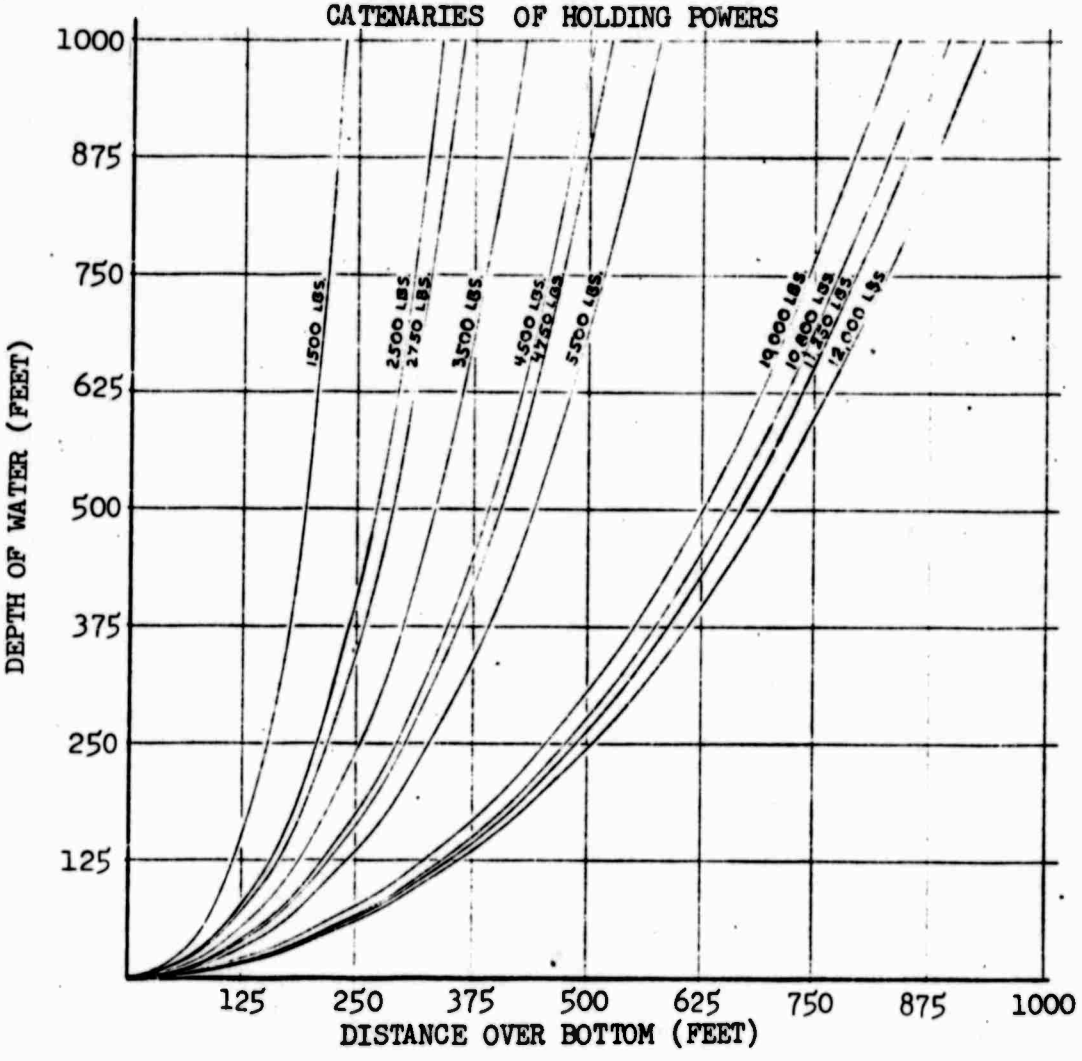


figure 8

4. Sea State Motions and Added Mass

When sea states are imposed during the recovery operation the lifting loads will naturally increase due to the increased motions of the ship and the increased wind. The motion analysis will be done at station "0" for roll pitch and heave.

Sea State 0 - No motions assumed.

Sea State 3 - 4 ft. waves 0 knots current

Motions	1.8 fps
Acceleration	2.0 ft/sec^2
Heave	1.3 fps @ midships
Pitch	.5 fps @ Sta. "0"

These motions were taken from a NAVSEC computer program of ship motions that has proven quite accurate in predicting motions in pitch and heave. A reasonable assumption for roll would be a value equal to 1.44 of pitch.

Distance of bolster off ℄	40 ft.
Distance of Sta "0" from ⊠	115 ft.

The roll would therefor be:

(1) $(.5)(1.44)\left(\frac{40}{115}\right) = .25$ fps

Motions for a sea state 3 would then be:

$$1.3 + .5 + .25 = 2.05 \text{ fps}$$

Acceleration $\frac{1.8}{2.05} = \frac{2}{X}$

$$1.8X = (2.05)(2)$$

$$X = 2.277$$

(2) $\underline{a = 2.277 \text{ ft/sec}^2}$

Sea State 4 — 7 ft waves 0 knots current

Motions	4.0 fps
Acceleration	3.9 ft/sec^2
Heave	1.9 fps @ midships
Pitch	2.1 fps @ Sta "0"

Assuming roll to be 1.44 of pitch

Distance of Bolster off ℄	40 ft.
Distance of bolster from ⊠	115 ft.

The roll would therefor be:

(3) $(2.1)\ (1.44)(\frac{40}{115}) = 1.052$ fps

Motions for a sea state 4 would then be:

$1.9 + 2.1 + 1.05 = 5.05$ fps

Acceleration $\frac{4}{5.05} = \frac{3.9}{X}$

$4x = (3.9)\ (5.05)$

$x = 4.9237$ ft/Sec^2

(4) $a = 4.9237$ ft/Sec^2

Added Mass of the Chain

Discussions with the Hydrodynamics people in NAVSEC indicated that added mass values of 160 lbs. and 1000 lbs. could be expected for sea states 3 and 4 consecutively.

Lift Load Requirements

The specifications for the ASR 21/22 Class required that the windlass machinery be capable of lifting 200 fathoms of 1½" high strength die lock chain plus a 5000 lb. anchor.

(5) (1 shot of 1½" chain = 2,260 lbs.)

200 fathoms	= 30,133 lbs.
1 anchor	= 5,000 lbs.
	35,133 lbs.

(6) $(35,133) \times (.872) = 30,636$ lbs.

The windlass was therefore required to lift an equivalent load of 30,636 lbs. (outside of the bolster).

A vertical lift in 1,000 ft. of water would see the following load:

(7) $(1000)\ (\frac{2260}{90})\ (.872) =$ 21,896 lbs.

A vertical lift in 1,000 ft. of water with motions from a sea state 3 imposed on the ship would yield the following lift loads:

(8) $L = (21,896) + (\frac{21,896}{32.2})(2.278) + (160) =$ 23,611 lbs.

If lifting were done in a sea state 3 with the ship being set down by wind the scope of the chain would be increased to 1,119 ft. The new lift load would be:

$$S = (1{,}119)\left(\frac{2260}{90}\right)(.872) = 24{,}503 \text{ lbs.}$$

$$(9) \quad L = (24{,}600) + \left(\frac{24{,}503}{32.2}\right)(2.278) + (160) = \underline{26{,}493 \text{ lbs.}}$$

If the lift were done in a sea state 3 with the ship being set down by wind and a 2 knot current the scope of the chain would increase to 1,425 ft. The new lift load would be:

$$S = (1425)\left(\frac{2260}{90}\right)(.872) = 31{,}203 \text{ lbs.}$$

$$(10) \quad L = (33{,}080) + \left(\frac{31{,}203}{32.2}\right)(2.278) + (160) = \underline{35{,}447 \text{ lbs.}}$$

Repeating the process for sea state 4 conditions - for a vertical lift the recovery loads are:

$$(11) \quad L = (21{,}896) + \left(\frac{21{,}896}{32.2}\right)(4.9237) + (1000) = \underline{26{,}244 \text{ lbs.}}$$

For a sea state 4 recovery with wind setting the ship down the scope increases to 1,149 ft. The resulting lift load is:

$$S = (1{,}149)\left(\frac{2260}{90}\right)(.872) = 25{,}159 \text{ lbs.}$$

$$(12) \quad L = (25{,}340) + \left(\frac{25159}{31.2}\right)(4.9237) + (1{,}000) = \underline{30{,}187 \text{ lbs.}}$$

For a sea state 4 recovery with wind and a 2 knot current setting the ship down the chain scope increases to 1,449 ft. The resulting lift load is:

$$S = (1440)\left(\frac{2260}{90}\right)(.872) = 31{,}428 \text{ lbs.}$$

$$(13) \quad L = (33{,}810) + \left(\frac{31{,}728}{32.2}\right)(4.4237) + (1000) = \underline{39{,}661 \text{ lbs.}}$$

If the chain were lifted in a calm sea with two knots of current the scope would be 1,331 ft. and the recovery loads would be:

$$(14) \quad L = (1331.)\left(\frac{2260}{90}\right)(.872) = \underline{29{,}144 \text{ lbs.}}$$

These values, plotted in figure 9, represent the loads that will be seen during various chain recovery conditions. They all assume that the ship is dead in the water and no effort is being made to lessen the load on the anchor chain. By the same token the load can be reduced by steaming up on the anchor chain and thus shortening the chain catenary.

5. SEA STATE RECOVERY REQUIREMENTS

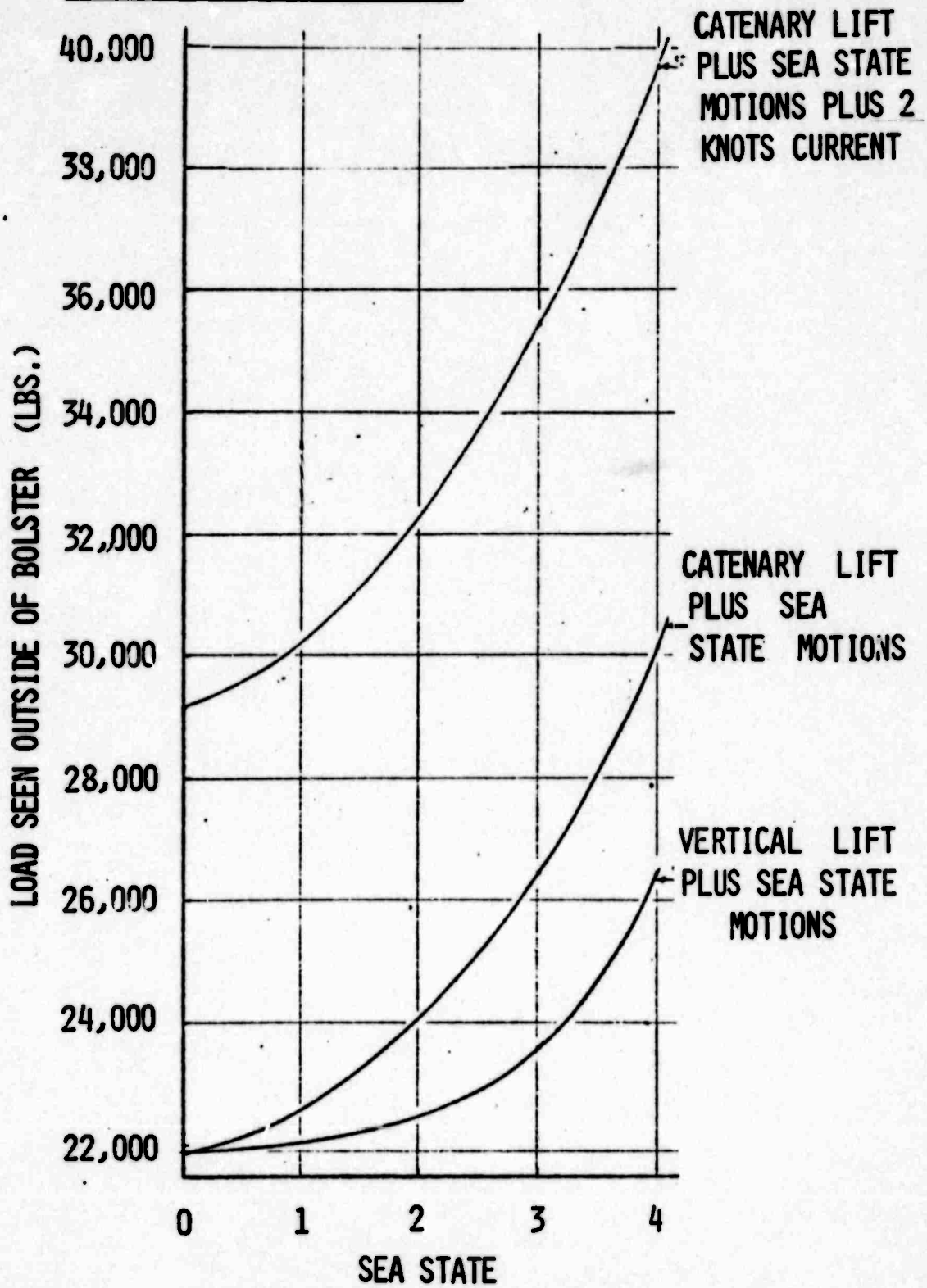


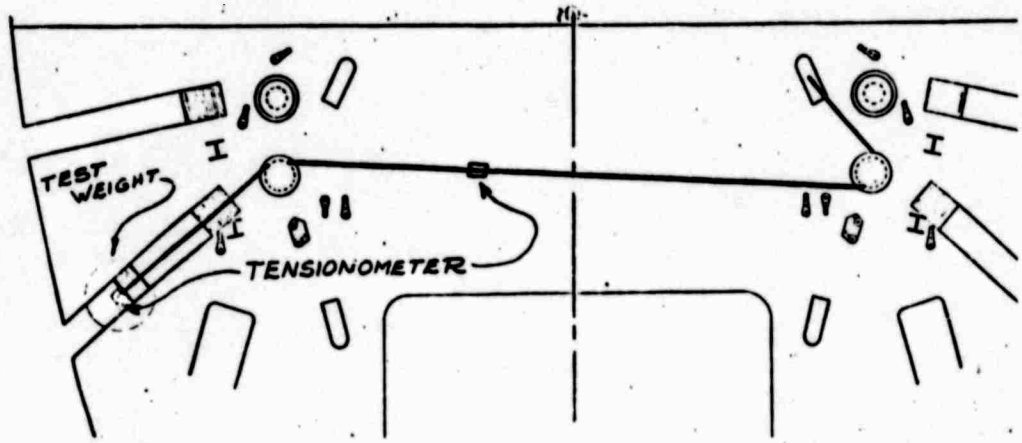
figure 9

IV PRESENT CAPABILITIES OF THE 4 POINT MOOR RECOVERY SYSTEM

1. Determine bolster efficincies

The bolster efficiencies were done on the ASR 22 while she was in drydock at the Philidelphia Naval Shipyard. The tests themselves were done by placing weights on the drydock floor and lifting them with the anchor chain the same way it is done in operation. To determine the efficiency of the bolster itself load cells were placed in the chain before and after the bolster to obtain the differential load in the chain as it passed over the bolster. This test is described in the following section.

2. Forward bolster efficiency test.



RIGGING ARRANGEMENT FOR FORWARD STARBOARD BOLSTER EFFICIENCY TEST

figure 10

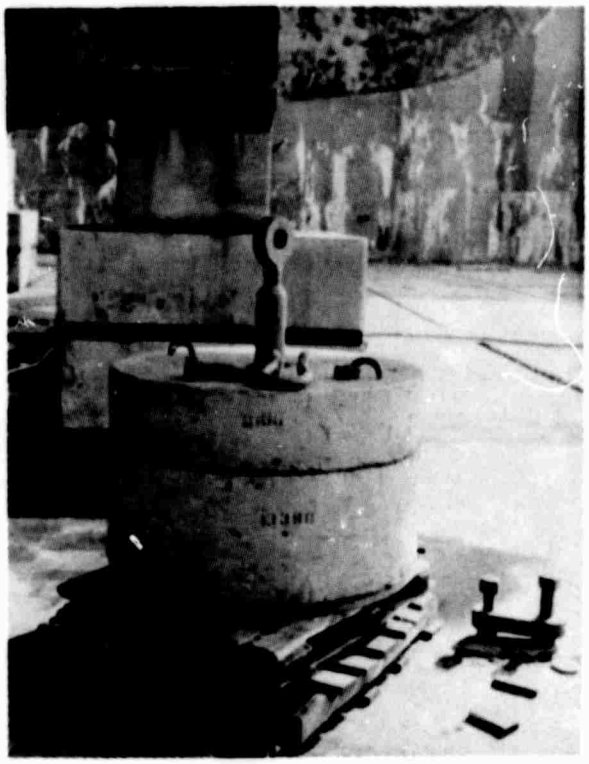
TEST SEQUENCE

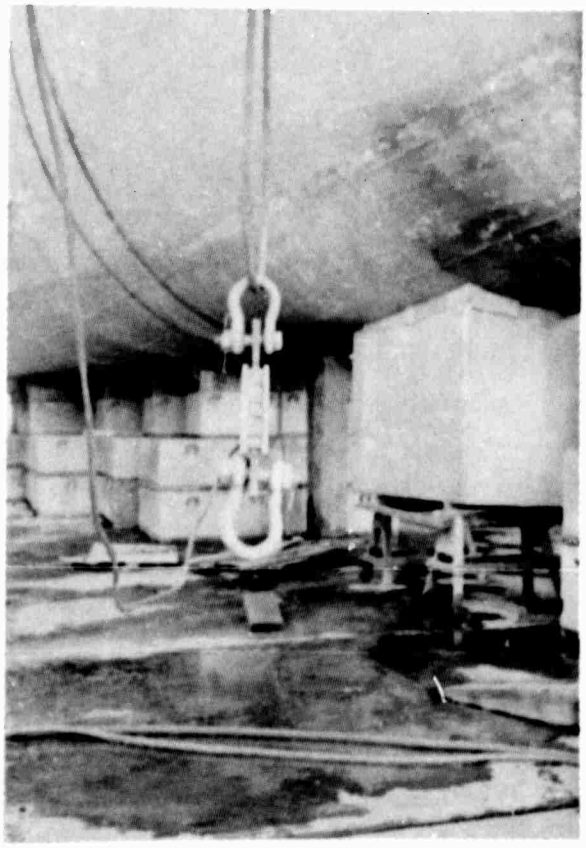
TEST	DESCRIPTION	REMARKS	TIME
1.	Calibration		13:29
2.	Heave in		13:55
3.	Up	Up Speed Setting 1	13:55
4.	Down	Down Speed Setting 2	
5.	Up	Up 3	
6.	Down	Down 2	
7.	Up	STALL	
8.	Up	STALL	
9.	Down		
10.	Up	STALL	
11.	Down		
12.	Up	STALL	
13.	Down		
14.	Up	STALL	
15.	Up	Up 4	

16.	Down	Down 4	
17.	Up	STALL	
18.	Down	JOG	
19.	Up	JOG	
20.	Down		
21.	Up		
22.	Down		
23.	Up	JOG	
24.	Down	Down & Up	
25.	Down	JOG	
26.	Up	STALL	
27.	Down		
28.	Up	STALL	
29.	Hold		14:18
30.	Down	JOG	
31.	Up	Up 4	
32.	Down		
33.	Up	Up 4 STALL	
34.	Down		
35.	Up	Up 4 STALL	
36.	Down		
37.	Up	STALL - HOLD	
38.	Down		
39.	Up	STALL	
40.	Down		
41.	Up	STALL	
42.	Down		
43.	Up	STALL	
44.	Down	7 Seconds	
45.	Up	Up 1 STALL	
46.	Down	Down 2 5 Seconds	
47.	Up	Up 4 STALL	
48.	Down	Wet Bolster Up 1	
49.	Up	Up 4 STALL	
50.	Down	Down-Up 4 STALL	
51.	Down	JOG	
52.	Up	STALL	
53.	Up	Up 4 STALL	
54.	Up	STALL	
55.	Up	STALL	
56.	Down	Weight reduced to 23,000#	
57.		Changing Weights	14:47
58.	Up	Dry Bolster Up 2	
59.	Up		
60.	Down	Down 4	
61.	Up	Up 4	
62.	Down	Down 4	
63.	Up	Wet Bolster Up 4	
64.	Down	Down 4	
65.	Up	Up 4	
66.	Down	Down 4	

TEST WEIGHT SHOWN AT BOTTOM OF DRYDOCK READY FOR HOOK UP TO LIFTING CHAIN.

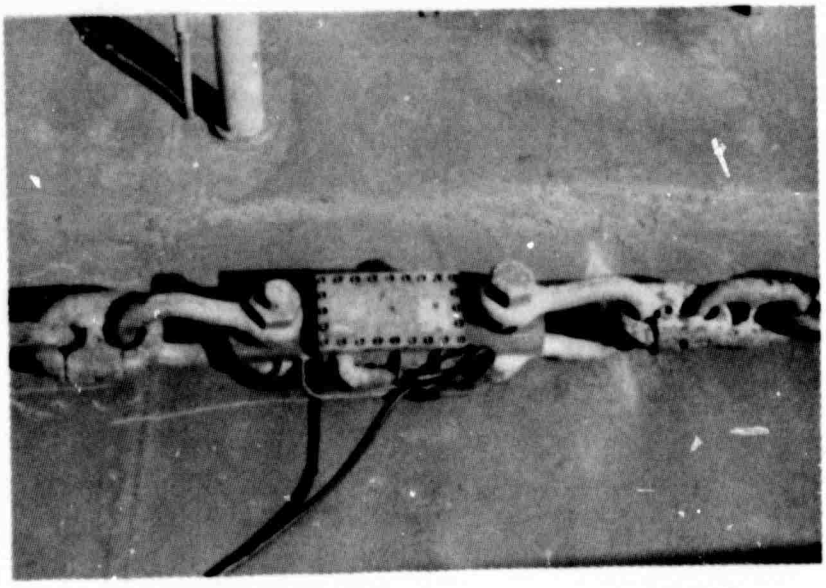
figure 11





TEST WEIGHT LOAD CELL SHOWN IN POSITION READY TO HOOK UP TO TEST WEIGHT BY PLATE SHACKLE SHOWN IN PHOTO ABOVE. WIRE STRAPS WERE USED TO TAKE UP FAIR-LEAD DIFFERENCES BETWEEN FORE AND AFT BOLSTERS.

figure 12

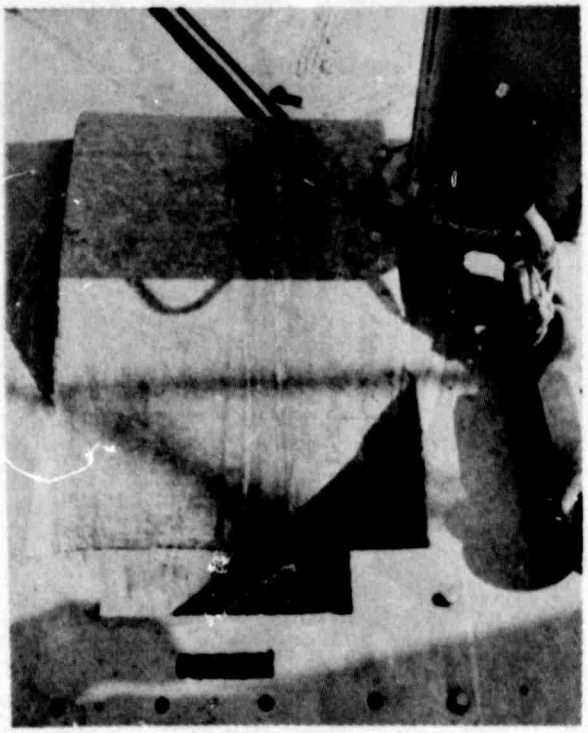


TOPSIDE IN-HAUL LOAD CELL RATED AT 100,000 LBS.

figure 13

OUTBOARD TEST WEIGHT LOAD CELL. RATED AT 100,000 LBS.

figure 14

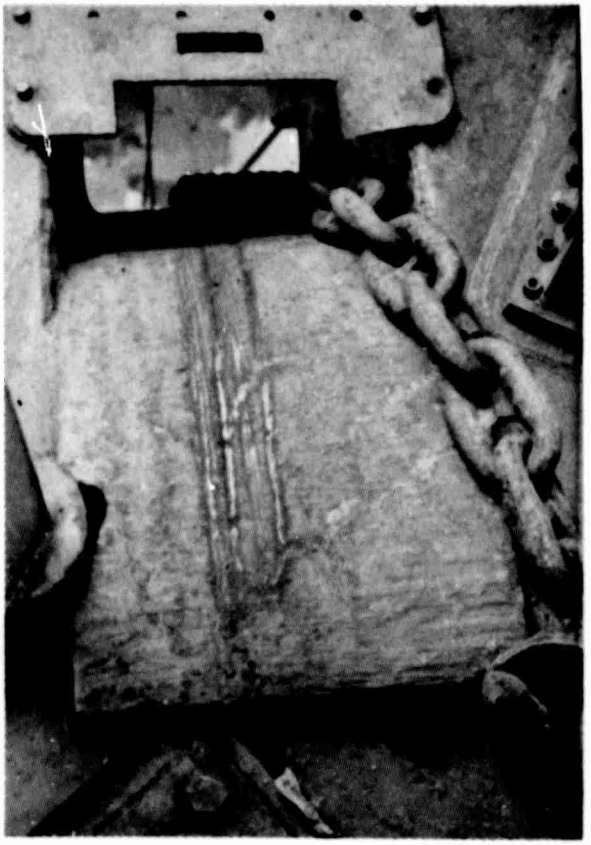


CONDITION OF THE STARBOARD FWD BOLSTER BEFORE THE TEST RUNS WERE STARTED.

figure 15

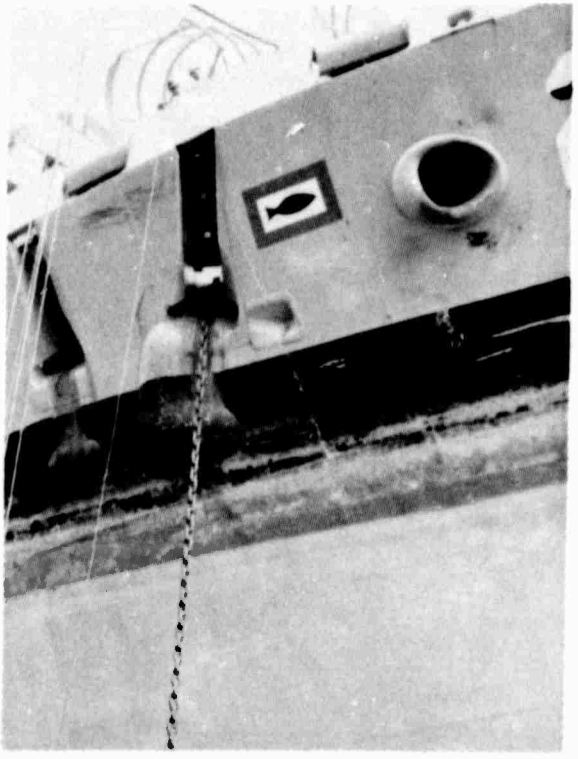
CONDITION OF THE STARBOARD FWD BOLSTER AFTER THE TEST RUNS WERE COMPLETED.

figure 16



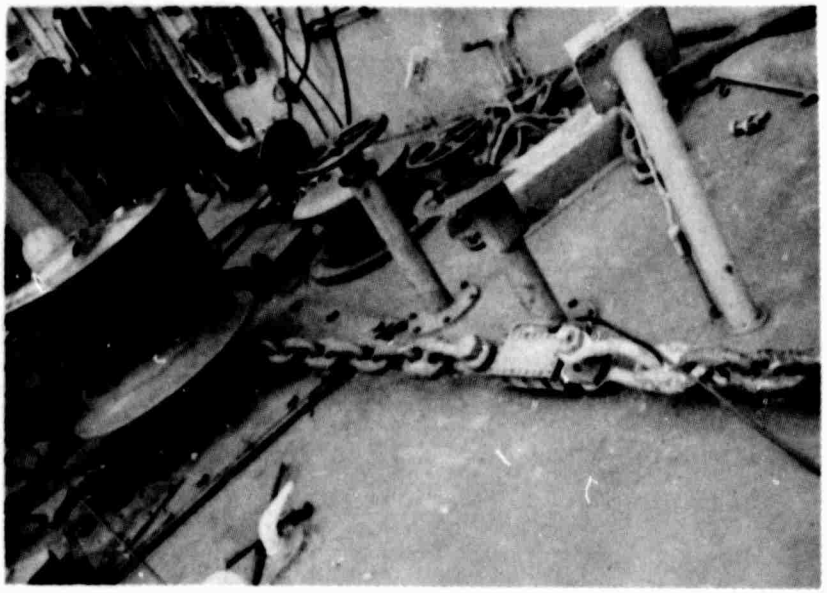
STARBOARD FWD BOLSTER, AFTER TEST RUNS WERE COMPLETED.

figure 17



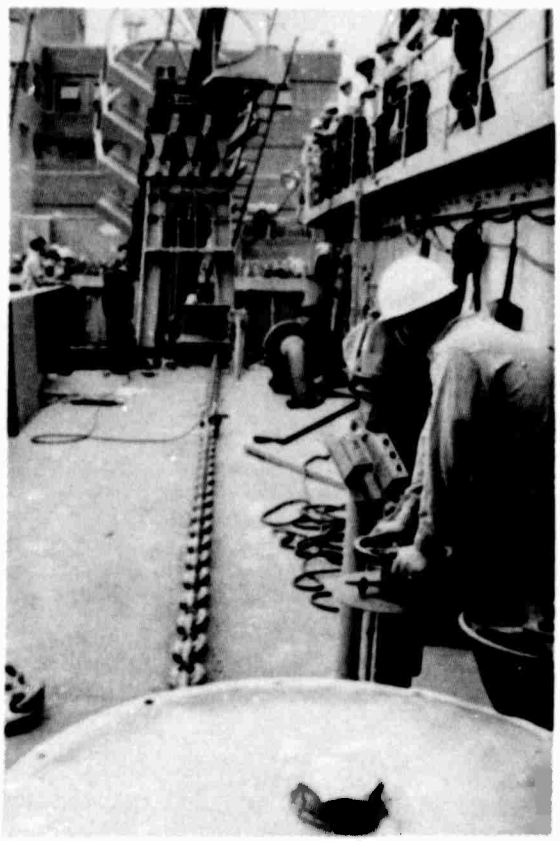
STARBOARD FWD BOLSTER IN THE RIGGED CONDITION PRIOR TO TEST RUNS.

figure 18



THE INHAUL LOAD CELL WAS INSTALLED AS SHOWN. THE EXTRA LOAD FROM THE WILDCAT (BEING USED AS AN IDLER) WAS SUBTRACTED FROM THE FINAL READINGS.

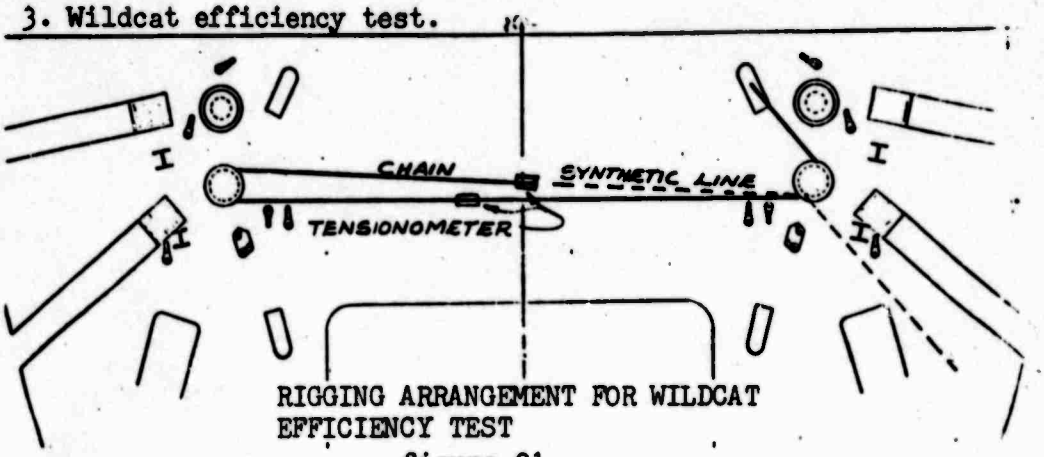
figure 19



THE HAULING FORCE FOR THE LIFT TEST WAS PROVIDED BY THE ACROSS DECK WINDLASS. THE LENGTH OF THE RUN WAS TIMED THUS GIVING SPEED VALUES.

figure 20

3. Wildcat efficiency test.



RIGGING ARRANGEMENT FOR WILDCAT EFFICIENCY TEST

figure 21

TEST	DESCRIPTION	REMARKS	TIME
85.	Start	Wildcat Idler Efficiency Test	
86.	Flat		
87.	Flat		
88.	Flat		
89.	Flat		
90.	Flat	STOP	
91	Flat	2nd Test	
92.	Flat		
93.	Flat		
94.	Flat		
95.	Flat		
96.	Flat		
97.	Flat		
98.	Flat		
99.	Peak		
100.	Peak		
101.	Flat		
102.	Flat		
103.	Flat		
104.	Flat		
105.	Flat		
106.	Flat		
107.	Flat		
108.	Flat		
109.	Stop		
110.	Start	Wildcat Idler Efficiency	
111.	Peak		
112.	Peak/Flat		
113.	Flat		
114.	Peak/Flat		
115.	Series Peaks/Flats		
116.	Flat		
117.	Flat		
118.	End		

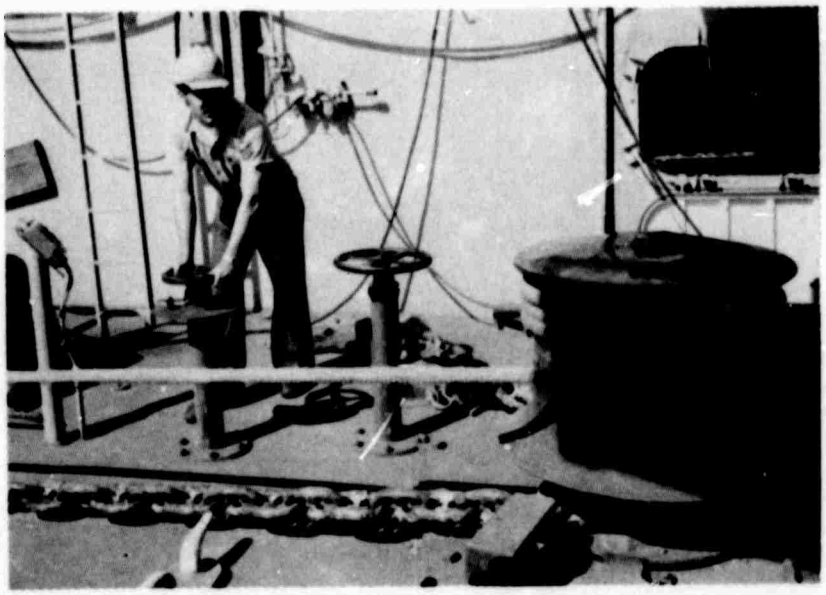
119.	Start	STALL Tests
120.	Up (1)	
121.	Up (2)	
122.	Up (3)	
123.	End/Start	2nd Test
124.	Up (1)	
125.	Up (2)	
126.	Up (3)	
127.	Up (4)	
128.	End/Start	3rd Test
129.	Up (1)	
130.	Up (2)	
131.	Up (3)	
132.	Up (4)	
133.	End/Start	4th STALL Test
134.	Up (1)	
135.	Up (2)	
136.	Up (3)	
137.	Up (4)	End STALL Test

WILDCAT EFFICIENCY TEST. LOAD CELLS WERE INSTALLED ON BOTH SIDES OF WILDCAT. ONE IN THE CHAIN RUN AND THE OTHER AT THE CONNECTION OF THE SYNTHETIC LINE.

figure 22

A RUNNING LOAD FOR THE TEST WAS ACCOMPLISHED BY HAULING IN ON THE CHAIN AND THE SYNTHETIC LINE AT THE SAME TIME. THE SYNTHETIC LINE WAS SLIPPED OVER THE CAPSTAN CREATING A BACK TENSION.

figure 23



CALCULATION WORK SHEET
SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

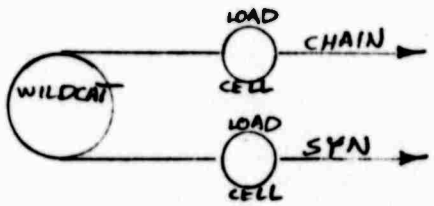
U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject WILDCAT EFFICIENCY Chkd. date
TESTS 85-108 Sheet No. of

(CHAIN PULL) IN LINE TENSIONOMETER		(SYN PULL) TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
20.0		14.7	
20.3		15.0	
18.4		13.4	
21.9		16.0	
18.6		14.1	
17.7		13.2	
21.5		17.0	
31.3		24.5	
22.3		17.5	
21.3		17.0	
16.9		14.2	
22.1		18.0	
20.9		17.3	
20.8		17.0	
20.6		16.7	
22.1		17.7	
20.3		16.3	
TOTAL 357.0		297.6	
AVE. 21.0000		16.4470	

DIFFERENCE 4.5530

WILDCAT DRAG 4,553#

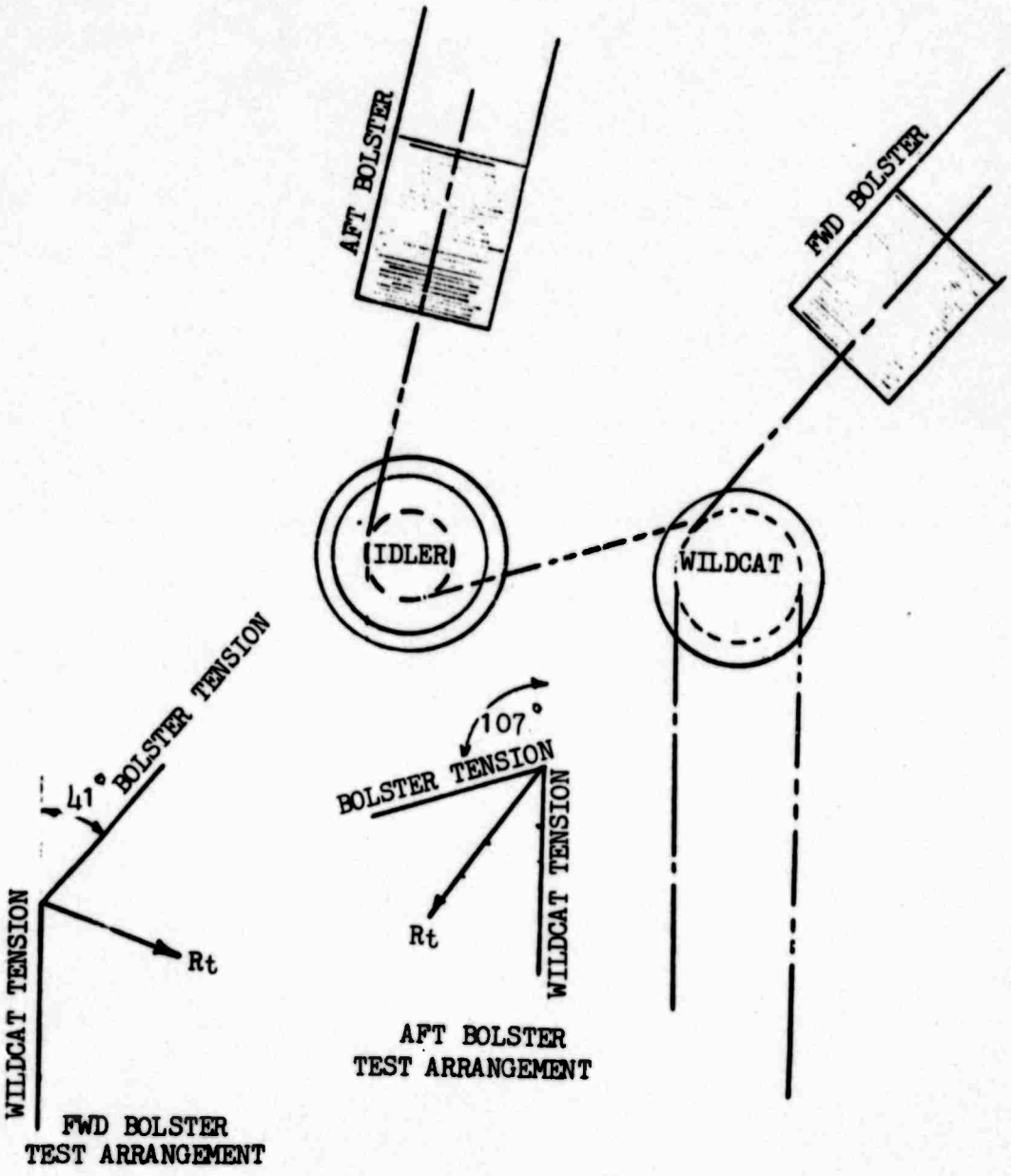
RESULTANT LOAD 37,447#



WILDCAT FRICTION μ = .1216
WILDCAT EFFICIENCY = 87.84%

CALCULATION WORK SHEET
SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject WILDCAT EFFICIENCY Chkd. date
Sheet No. of



RIGGING ARRANGEMENT FOR BOLSTER EFFICIENCY TEST USING A WILDCAT AS AN IDLER.

figure 24

CALCULATION WORK SHEET
SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject WILDCAT DRAG Chkd. date
Sheet No. of

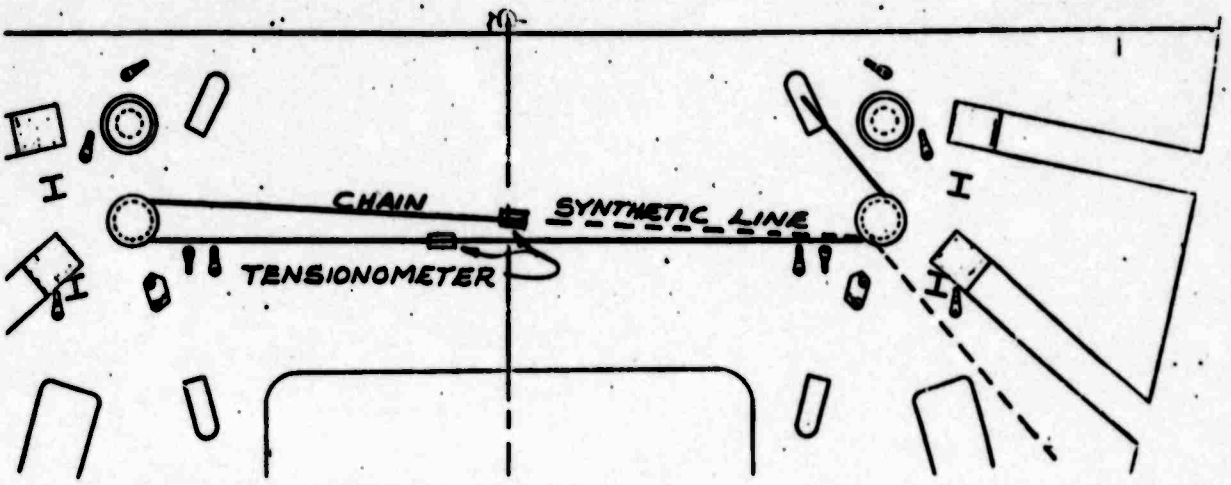


figure 25

FOR A WRAP OF 180° THE CAPSTAN SHOWED A MEAN DRAG LOAD OF 4,553 LBS. FOR A CHAIN PULL of 21,000 LBS.

∴ ASSUME A $\mu_w = \frac{4,553}{21,000} = .2168$

USING A SIMPLIFIED APPROXIMATION OF THE DRAG FOR VARIOUS WRAPS OF THE CAPSTAN WE HAVE:

FOR INHAUL: $DRAG_1 = (\text{MEAN CHAIN LOAD})(\mu_w)(\frac{\text{WRAP}}{180°})$

$DRAG_1 = (MCL)(.2168)(\frac{41}{180})$
$DRAG_1 = .0494(MCL)$

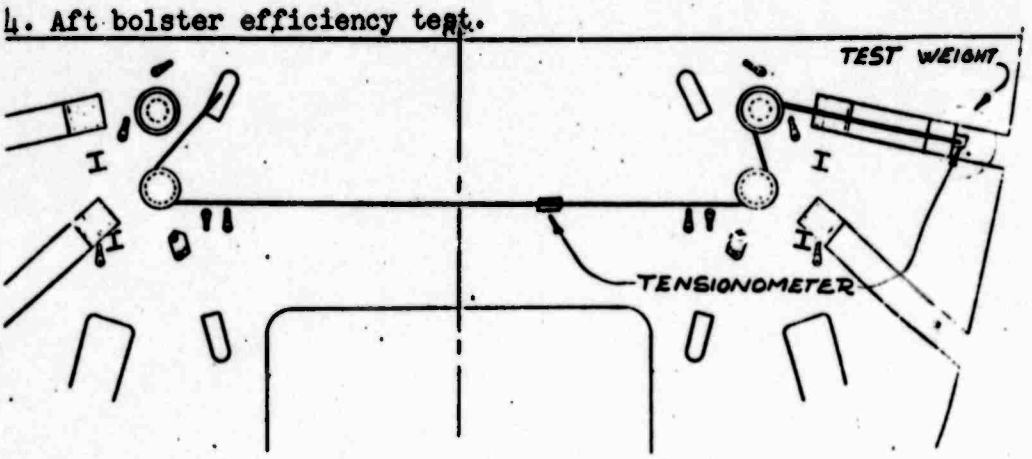
$DRAG_2 = (MCL)(.2168)(\frac{107}{180})$
$DRAG_2 = .1288(MCL)$

FOR LOWERING: $DRAG = (\text{MEAN BACKHAUL LOAD})(\mu_w)(\frac{\text{WRAP}}{180})$

$DRAG_1 = (MBL)(.2768)(\frac{41}{180})$
$DRAG_1 = .0636(MBL)$

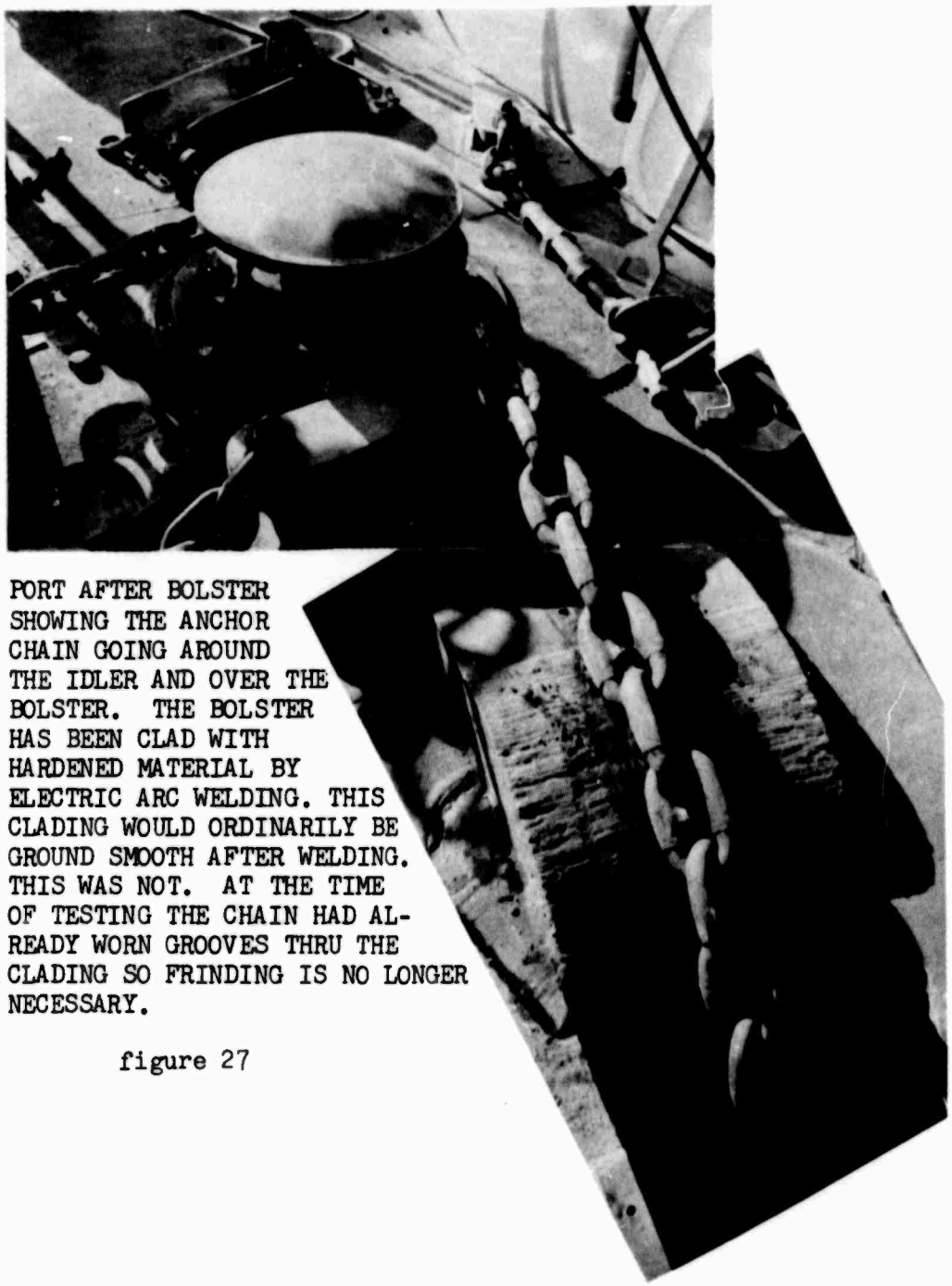
$DRAG_2 = (MBL)(.2768)(\frac{107}{180})$
$DRAG_2 = .16573(MBL)$

4. Aft bolster efficiency test.



RIGGING ARRANGEMENT FOR AFT PORT
BOLSTER EFFICIENCY TEST
figure 26

TEST	DESCRIPTION	REMARKS	TIME
138.	Start of Port After Bolster		16:37
139.	Up (1)		
140.	Heave Up		
141.	Heav Up Both Wildcats		
142.	Chain Slipped		
143.	Heave Up		
144.	Down		
145.	Heave Up		
146.	Down		
147.	Up (4)		
148.	Down (4)		
149.	Up (4) Wet		
150.	Down (4)		
151.	Up (4)		
152.	Down (4)		
153.	Up (2)	STALLED	
154.	Down		
155.	Up - STALL		
156.	Down		
157.	Up (4)		
158.	Down (4)		
159.	Up (4)	STALL	
160.	Down		
161.	Up (4)	STALL?	
162.	Up (4)	STALL (Damp)	
163.	Up (4)	STALL	
164.	Down/Up		
165.	Up (4)	STALL	
166.	Down		



PORT AFTER BOLSTER SHOWING THE ANCHOR CHAIN GOING AROUND THE IDLER AND OVER THE BOLSTER. THE BOLSTER HAS BEEN CLAD WITH HARDENED MATERIAL BY ELECTRIC ARC WELDING. THIS CLADING WOULD ORDINARILY BE GROUND SMOOTH AFTER WELDING. THIS WAS NOT. AT THE TIME OF TESTING THE CHAIN HAD ALREADY WORN GROOVES THRU THE CLADING SO FRINDING IS NO LONGER NECESSARY.

figure 27

RIGGING OF THE STARBOARD AFT BOLSTER PRIOR TO TEST RUNS. THIS SHOWS FAIRLEADING REQUIRED TO INSTALL THE 100K LOAD CELL. THIS TEST WAS CANCELED DO TO A FROZEN IDLER. UNSUCCESSFUL ATTEMPTS WERE MADE TO BREAK IT FREE. THE TEST WAS MOVED TO THE PORT SIDE WHERE THE SAME ARRANGEMENT WAS USED.

figure 28

5. Bolster efficiencies.

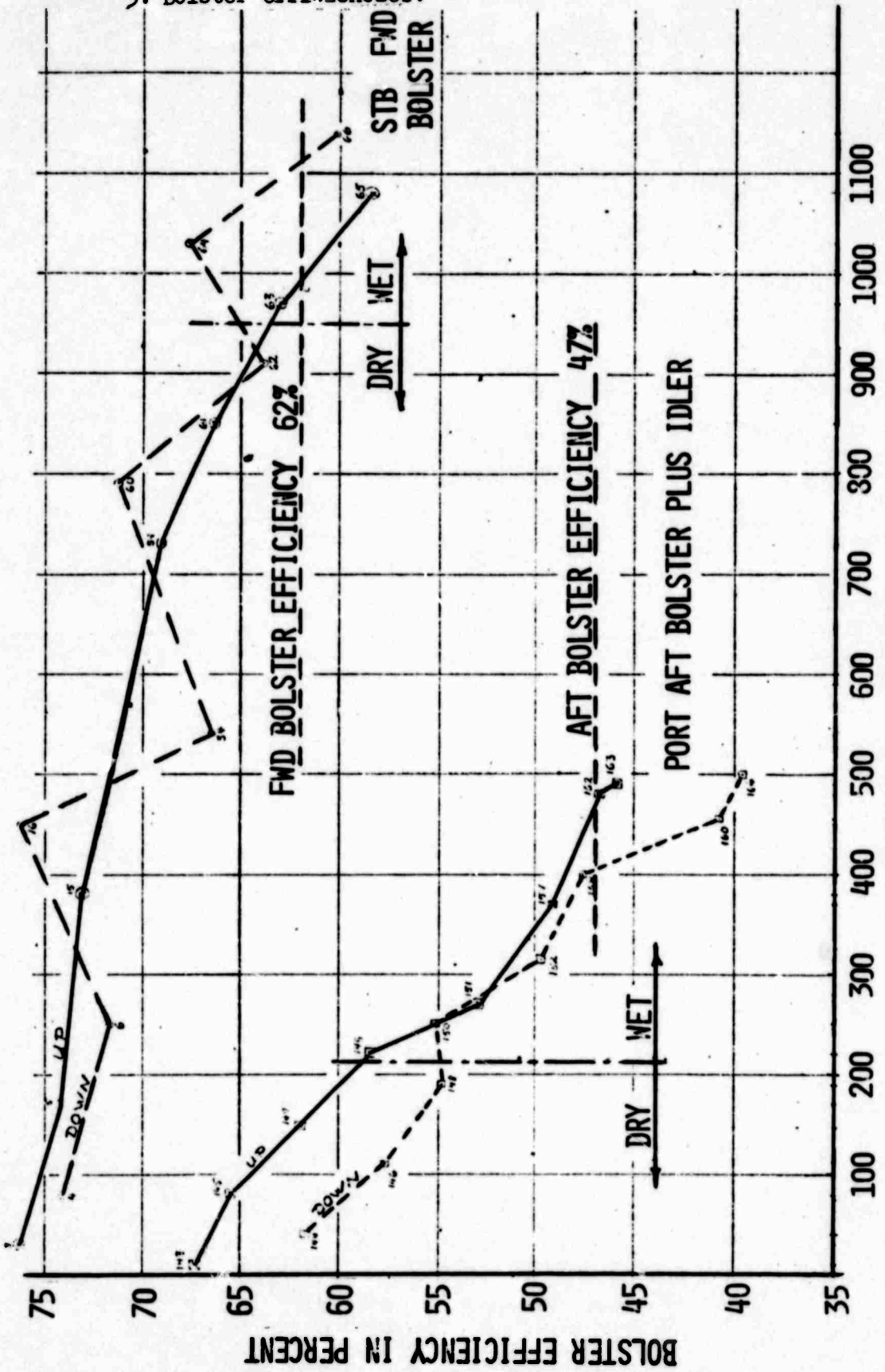


figure 29

Based on the efficiencies determined in the bolster tests the lift capacity of the windlasses aboard the ASR 22, with a pressure relief setting of 3500 psi, is as shown below:

EXISTING WINDLASS LIFT CAPACITY FOR ASR 22
(3500 PSI RELIEF VALVE)

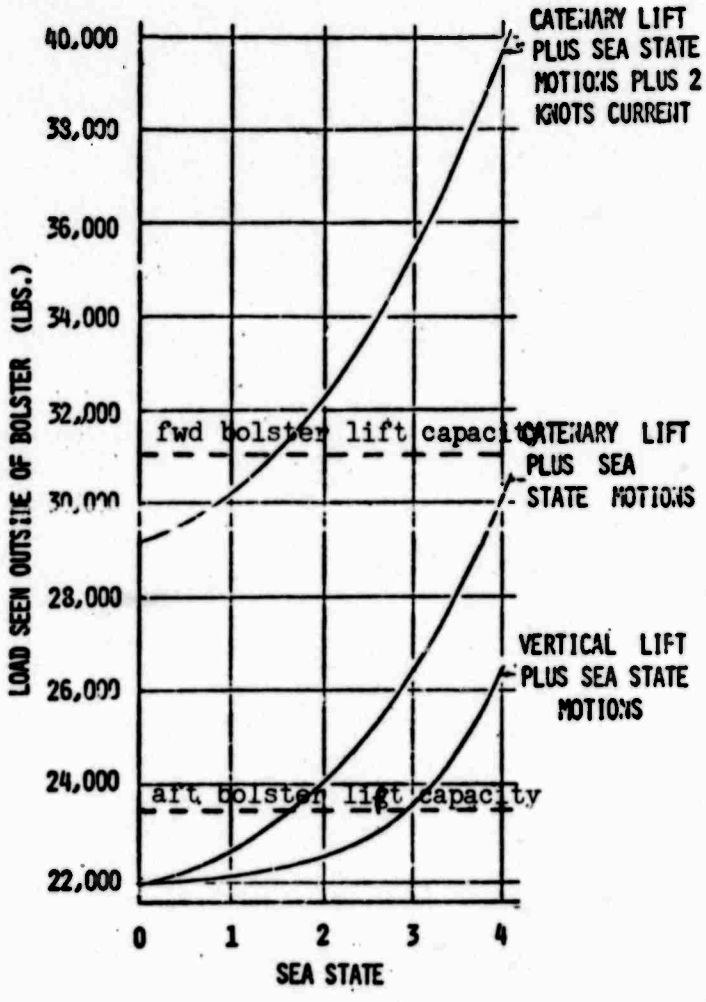


figure 29a

V CONCLUSIONS

An analysis of the above deficiencies, the anchor windlass design information, and the available test data, lead NAVSEC to the following conclusions:

A. Anchor Chain Jumping on the Wildcat

Insufficient anchor chain wrap is the primary cause for chain jumping on the wildcat. The secondary cause is twist of the chain between the wildcat and the chain locker bolster and orientation of the detachable links with the wildcat. The effect of the anchor chain twist and the detachable link orientation has been experienced on other ships, the difference being that the deficiency was less pronounced since less chain load was being applied. In addition to the above, a factor causing the chain to jump is the fact that the strain on the anchor chain between the wildcat and chain locker is substantially lower than the strain in the chain between the wildcat and anchor. High strain in a chain ordinarily causes better engagement of the chain with the wildcat as observed during anchor chain retrieval operations. The best solution to preclude the anchor chain jumping would be to redesign the anchor handling systems to provide a 180^{o} chain wrap on the wildcat or to increase strain in the anchor chain from the chain locker to the wildcat for better chain engagement. Both these solutions are expensive alterations. NAVSEC believes that further improvement of the chain system by (1) further increase of the anchor chain wrap angle, (2) eliminating twist in the anchor chain between wildcat and the bitter end shackle in the chain locker, (3) orienting all "D" links so that their flat surfaces are in the plane parallel to the deck, (4) ensuring that the centerline of the anchor chain on the deck tray, chain guides, and the wildcat are on the same level, (5) and greasing the wildcat whelps chain guide and deck tray before each operation will rectify the problem. The difficulty of anchor chain retrieval can be resolved by increasing tolerances in the horizontal groove (parallel to deck) of the chain guide and ensuring that the centerline of the anchor chain between wildcat and hawsepipe is on the same level. If further difficulties are encountered the chain guide can be redesigned so that it can be partially or completely removed during anchor chain retrieval evolution.

B. Electric Motor Overload and Stall

The tests conducted and recorded by PIGEON and ORTOLAN do not indicate an overload or stall of the electric motors except for two surge loads recorded by PIGEON during her 17 October 1974 forward port windlass test. As stated above, tests were not conducted at sea state 3, but at sea state 1 or 2. The

surges of amperage experienced by PIGEON on 17 October 1974 were 80 amps and 83 amps. These surges indicate that electric motor was overloaded 1.5% and 5.1% respectively. Such overloads are negligible since electric motors can be overloaded momentarily as high as 200% of the rated full HP. load. It should be noted that such overloads are not critical if they are not continuous. As far as electric motor stall is concerned (reported by ORTOLAN verbally) there is no possibility of this happening unless the main pressure relief valve and the horsepower limiter are set above 4,000 psig and 3500 psig respectively. According to the technical manual for the windlass the main pressure relief valve is set at 3500 psig and the horsepower limiter at 3000 psig. These settings preclude a stall of the electric motor since any of the overloads that could occur would cause the pressure relief valve to lift thus protecting the motor from any additional overload. It is believed that the main relief valves and horsepower limiters on ORTOLAN's anchor windlass are set in accordance with the machinery's technical manual. PIGEON has not reported any electric motor problems. Investigation reveals that relief valves and horsepower limiters aboard PIGEON are set at 4,500 psig and 4,000 psig per a NAVSHIPYD HUNTERS POINT alteration. This must be corrected by adjusting the maximum settings to 4,000 psig for the relief valve and 3,500 psig for the horsepower limiter to prevent a possible electric motor stall.

C. Hydraulic Components (Pump, Motors) and Fluid Overheat

There is no test data indicating that the hydraulic components or that the fluid overheats. All records show that the temperatures and hydraulic fluids are within the operating limits. It should be pointed out that the windlasses were tested at sea state 1 and 2 and not at sea state 3 at which the windlasses must be operable. Therefore, the forward windlasses should be tested at sea state 3 and all performance data (electric motor amp, volts, temperature of hydraulic pump motor, fluid and ambient) recorded. Based on this information, the need for a cooler can be determined. Without this information the size of the cooler can be only estimated by assuming that 50% of the horsepower of the hydraulic motor is converted to heat. Therefore, for the present anchor handling system, it is estimated that a 1,000 Btu cooler could be used.

D. Travel of Wildcat Locking Head Dogs in the Slots

ORTOLAN is the only ship experiencing this abnormality. Investigation of this deficiency shows that it can be caused by dragging of either the handbrake or the hydraulic brake (brake linings are not completely released). Also, this abnormality could be caused by wildcat shaft bushing distortion, insufficient tolerance between bushings and wildcat shafts, or by too much deflection of the

wildcat shaft during operation. All these causes should be investigated to resolve the problem.

E. Wildcat Shaft Bushings Damaged

The wildcat shaft bushings were damaged only aboard ORTOLAN. It is believed that their damage was caused by hammering of the wildcat locking head dogs. Resolution of locking head dogs hammering will preclude wildcat bushing damage.

F. Anchor Windlass System

Review of the anchor windlass design calculations shows that the anchor windlass was designed to handle a load of 47,130 pounds. This load included the weight of 200 fathoms of anchor chain, anchor plus bolster friction. For calculations of bolster friction, the manufacturer assumed a bolster efficiency of 65%. No loads due to sea state or currents were included in the design of the anchor windlass. The validity of the bolster efficiency of 65%, was questioned. NAVSEC/NAVSHIPYD PHILA was tasked to determine bolster efficiencies aboard ASR 21/22 Class ships. Their findings indicate that the forward deep sea mooring bolster efficiency is 62% whereas aft bolster efficiency is 47%. Further, the maximum load outside of the bolster at sea state 3, when the chain is lifted vertically (no catenary in the chain), is about 23,6000 pounds. The load in sea state 3 with catenary lift is about 26,200 pounds, and the load in sea state 3, plus 2 knots current, with catenary is about 35,500 pounds as shown on figure (9). Assuming that the NAVSEC/ NAVSHIPYD PHILA test data is correct, the present windlass should have no difficulty raising vertically the fwd and aft anchors and chains at sea state 3. See figure (9). The capability of the anchor windlass to raise the fwd and aft anchors and chains at sea state 3 with catenary is marginal, whereas the recovery of the anchor and chain at sea state 3, 2 knots current with catenary is impossible since the prime mover electric motor, must be of the 91 HP capacity. Further, investigation reveals that the present anchor windlass capability can be increased by setting the main pressure relief valve at 4,000 psig and horsepower limiter at 3,500 psig. These settings have been concurred by the windlass manufacturer. In view of the forgoing, there is no need for modification of anchor windlass if the operational procedure is imposed on the ships to retrieve their anchors and anchor chains at sea state 3 vertically or at lower sea state (1-2). If the anchor windlasses must have the capability of retrieving anchor chains at sea state 3, 3 knots current and with catenary, then the prime movers must be upgraded to 100HP (91 HP is required), main pressure relief valve set at 4,500 psig, horsepower limiter set at 4,000 psig, filtering system upgraded, and a cooler added.

VI RECOMMENDATIONS

In view of the above, it is recommended that NAVSHIPYD PHILA performs the following:

A. Anchor Chain Jumping on Wildcat

(1) Verify each anchor chain common link and Detachable link for proper dimensions.
(2) Ensure that there is no twist in the anchor chain between wildcat and bitter end shackle.
(3) Ensure that all Detachable links are vertically position positioned (perpendicular to the wildcat).
(4) Install a chain guide at a position which will provide maximum chain wrap on the wildcat.
(5) Each ship must grease wildcat whelps, chain guide, and deck tray before each operation.
(6) Ensure that the centerline of the anchor chain on the wildcat, the chain guide, and the deck tray is on the same level.
(7) Increase tolerances for the horizontal groove parallel to the deck on the chian guide.
(8) Redesign chain guide to make it partially or totally removable during anchor chain retrieval.
(9) Test above fixes by operating anchor windlasses at 1,000 foot depth of water and at sea state 3 while powering out 30 shots of chain.

B. Electric Motor Overload and Stall

(1) Test anchor windlass at 1,000 feet water and at sea state 3 to determine overloads by powering out 30 shots of chain and record necessary data.

C. Hydraulic Components and Fluid Overheat

(1) The same as paragraph b(1) above.
(2) Set main pressure relief valve at 4,000 psig and HP limiter at 3,500 psig.

Improved windlass performance at 4000 psi setting

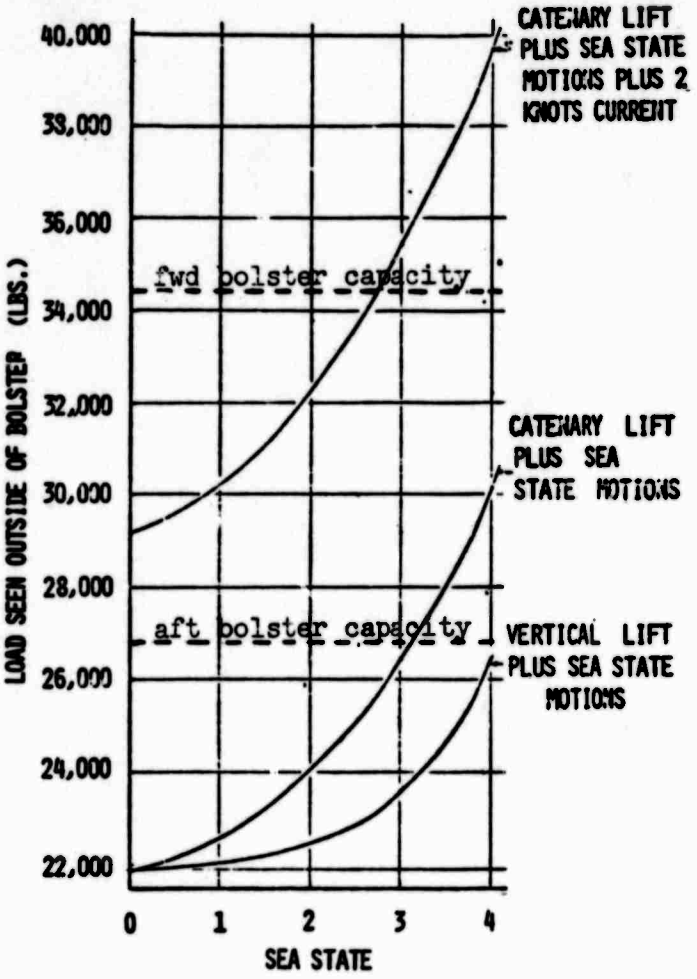


figure 30

D. Travel of Locking Head Dogs in Their Slots

(1) Investigate performance of the hydraulic brake.

(2) Investigate adequacy of the present tolerances used between wildcat shaft bushings and shaft.

(3) Investigate wildcat shaft deflection under the anticipated loads.

E. EMERGENCY SYSTEM FOR MOORING LEG RECOVERY

The emergency system for mooring leg recovery is to be used when deep mooring coupled with high sea state excedes the capability of the standard one wildcat recovery mode.

RECOVERY OF AFTER MOORING LEG USING TWO WILDCATS

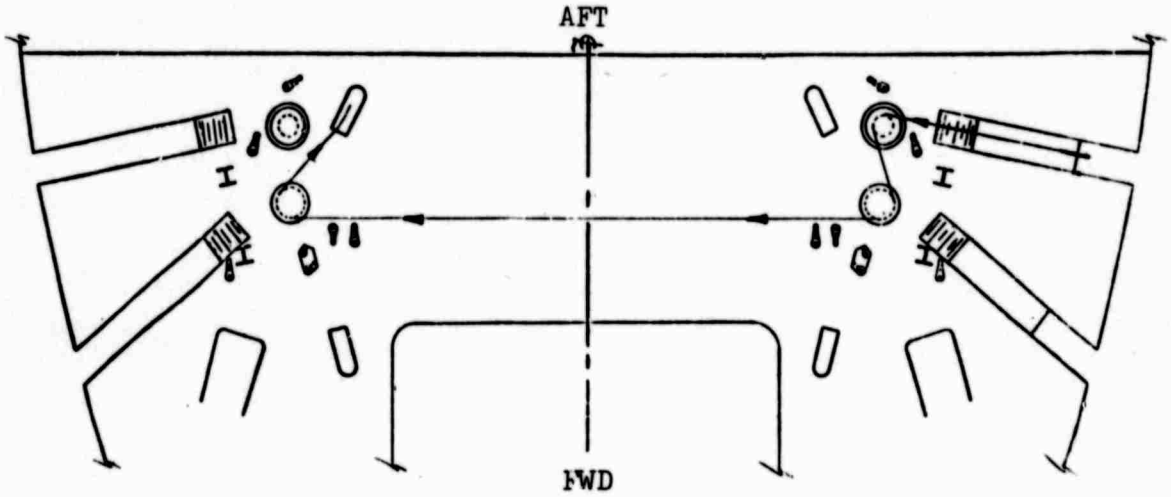


figure 31

RECOVERY OF FOWARD MOORING LEG USING TWO WILDCATS AND PORTABLE CHAIN GUIDE

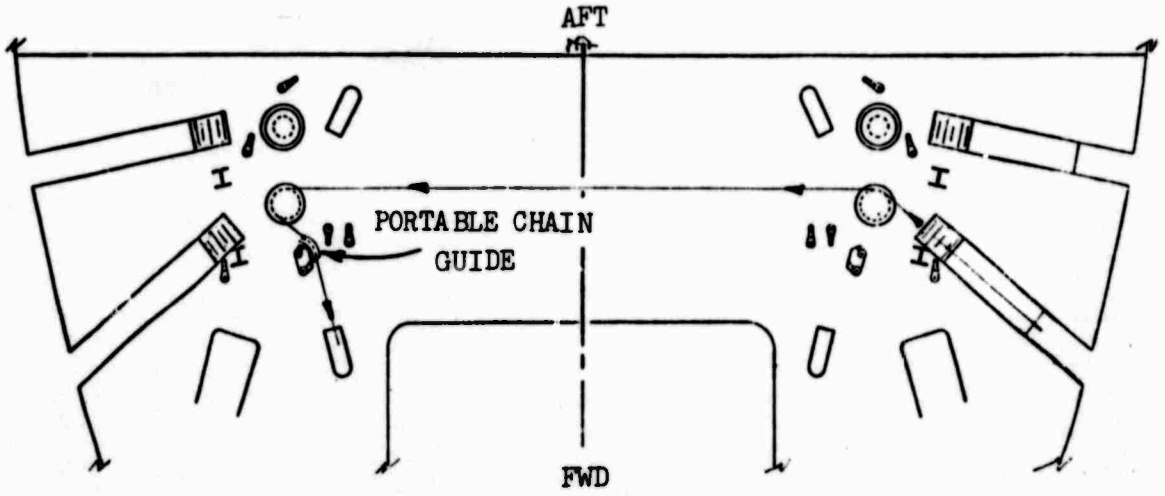


figure 32

Lift capacity of aft bolster in crossrig mode.

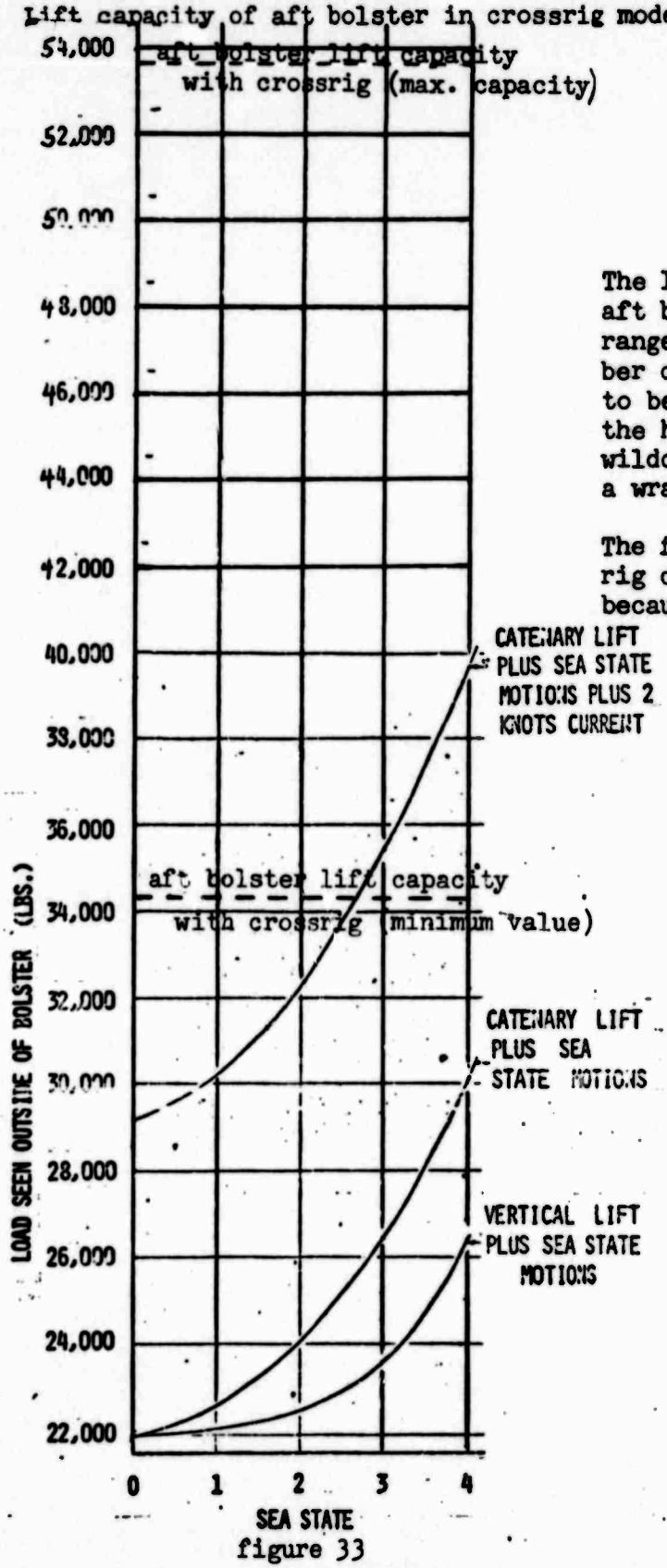


figure 33

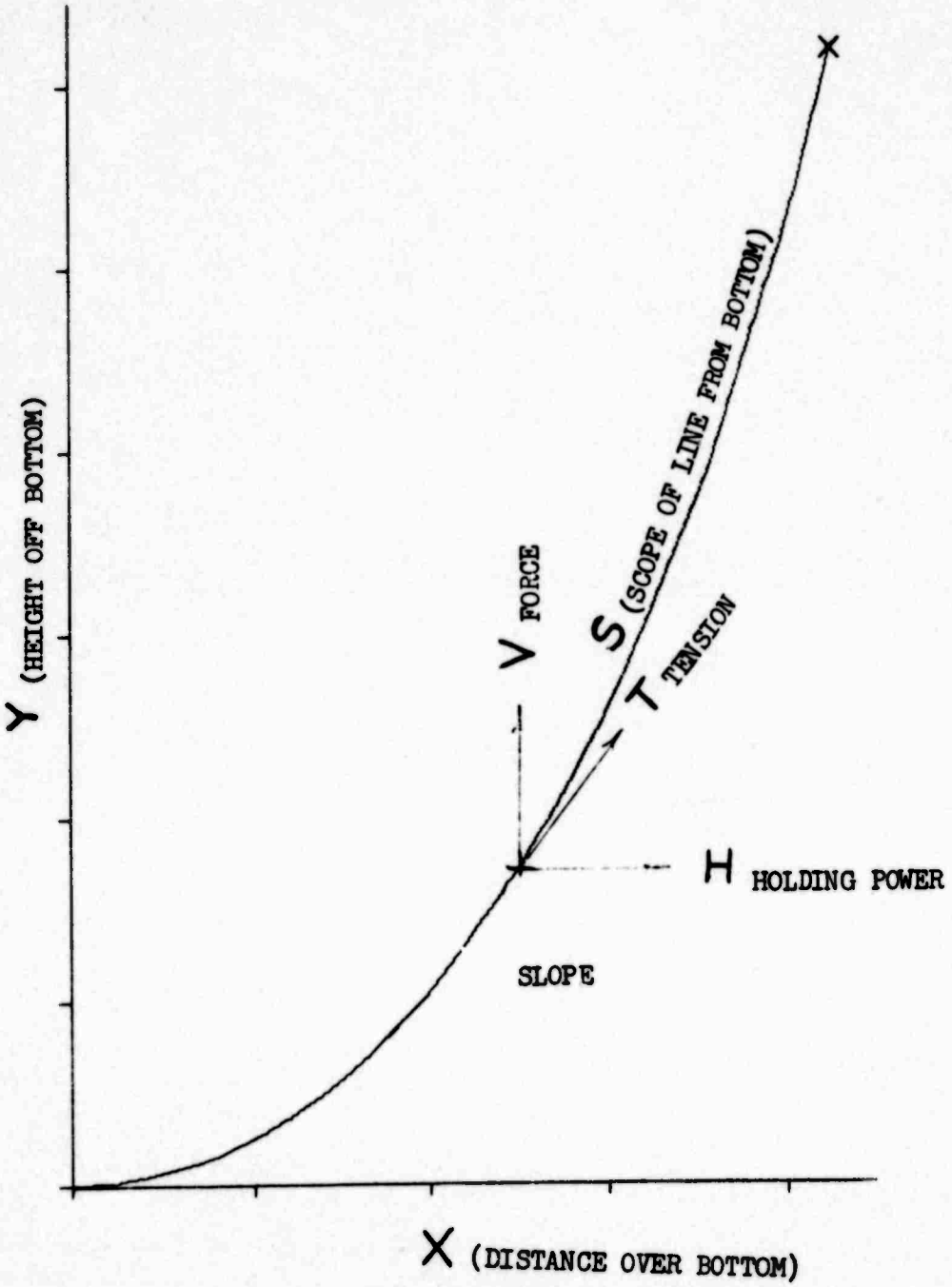
The lifting capacity over the aft bolster is shown as a range because of the number of variables that come to bear in calculating the the hauling capacity of a wildcat that does not have a wrap of 180°.

The forward bolster crossrig chart is not shown here because it is in excess of the aft bolster and is not envisioned as being needed except for the case of a windlass failure.

APPENDIX A

COMPUTER PRINTOUT OF CHAIN CATENARIES

The following is a computer printout of the chain catenaries generated by an ASR 21/22 class ship when moored in 1000 feet of water. The catenaries depict mooring loads ranging from 1,500 lbs. to 12,000 lbs.. A graphic display of the printout is shown below.



CATENARY FORMAT FOR COMPUTER DISPLAY

SUPERCAT

NO OF CATS= 1 HOLDING POWER= 1500.0

WTFT 21.8457 LENGTH OF LINE 1200.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	1500.00	0.00
12.06	1.06	12.1	10.01	1523.19	264.73
23.76	4.15	24.2	19.45	1590.74	529.59
34.85	9.03	36.4	27.91	1697.36	794.38
45.16	15.39	48.5	35.23	1836.26	1059.17
54.65	22.92	60.6	41.43	2000.72	1323.97
63.35	31.36	72.7	46.65	2184.99	1588.75
71.32	40.49	84.8	51.02	2384.46	1853.56
78.62	50.15	97.0	54.70	2595.65	2118.35
85.35	60.24	109.1	57.81	2815.91	2383.14
91.56	70.64	121.2	60.47	3043.28	2647.94
97.32	81.31	133.3	62.75	3276.23	2912.73
102.68	92.18	145.5	64.73	3513.78	3177.52
107.68	103.22	157.6	66.45	3754.94	3442.32
112.37	114.40	169.7	67.97	3999.03	3707.11
116.78	125.69	181.8	69.31	4245.71	3971.91
120.95	137.07	193.9	70.50	4494.60	4236.71
124.88	148.53	206.1	71.57	4744.83	4501.49
128.62	160.07	218.2	72.53	4996.75	4766.29
132.17	171.66	230.3	73.40	5249.93	5031.09
135.55	183.29	242.4	74.19	5504.21	5295.87
138.78	194.99	254.5	74.90	5759.43	5560.67
141.87	206.70	266.7	75.56	6015.48	5825.46
144.83	218.45	278.8	76.16	6272.26	6090.25
147.67	230.24	290.9	76.72	6529.67	6355.05
150.40	242.05	303.0	77.23	6787.66	6619.84
153.03	253.88	315.1	77.71	7046.15	6884.64
155.56	265.73	327.3	78.15	7305.09	7149.43
158.01	277.60	339.4	78.56	7564.44	7414.22
160.37	289.49	351.5	78.95	7824.15	7679.02
162.65	301.40	363.6	79.31	8084.19	7943.81
164.87	313.31	375.8	79.64	8344.53	8208.61
167.01	325.24	387.9	79.96	8605.14	8473.41
169.10	337.18	400.0	80.26	8866.00	8738.19
171.12	349.13	412.1	80.54	9127.09	9002.99
173.08	361.10	424.2	80.81	9388.38	9267.78
174.99	373.07	436.4	81.06	9649.87	9532.57
176.85	385.04	448.5	81.30	9911.53	9797.37
178.66	397.03	460.6	81.52	10173.35	10062.16
180.42	409.02	472.7	81.74	10435.32	10326.95
182.15	421.02	484.8	81.94	10697.44	10591.75
183.82	433.02	497.0	82.13	10959.68	10856.54
185.46	445.03	509.1	82.32	11222.04	11121.33
187.07	457.05	521.2	82.50	11484.51	11386.13
188.65	469.07	533.3	82.66	11747.08	11650.92
190.16	481.09	545.4	82.83	12009.76	11915.72
191.66	493.12	557.6	82.98	12272.52	12180.51
193.13	505.15	569.7	83.13	12535.37	12445.30
194.56	517.19	581.8	83.27	12798.30	12710.10
195.97	529.23	593.9	83.41	13061.31	12974.89
197.35	541.27	606.1	83.54	13324.39	13239.68
198.70	553.31	618.2	83.66	13587.53	13504.48
200.02	565.36	630.3	83.79	13850.73	13769.27
201.32	577.41	642.4	83.90	14114.00	14034.07
202.60	589.47	654.5	84.01	14377.32	14298.86

203.15	601.52	666.7	84.12	14640.71	14563.65
205.08	613.50	678.8	84.22	14904.12	14828.45
206.29	625.64	690.9	84.32	15167.59	15093.24
207.49	637.71	703.0	84.42	15431.11	15358.03
208.65	649.77	715.1	84.52	15694.67	15622.83
209.80	661.84	727.3	84.61	15958.27	15887.62
210.93	673.90	739.4	84.69	16221.91	16152.42
212.04	685.97	751.5	84.78	16485.59	16417.21
213.13	698.05	763.6	84.86	16749.30	16682.00
214.21	710.12	775.7	84.94	17013.05	16946.80
215.27	722.19	787.9	85.02	17276.83	17211.59
216.32	734.27	800.0	85.09	17540.64	17476.39
217.34	746.35	812.1	85.17	17804.48	17741.19
218.36	758.43	824.2	85.24	18068.34	18005.97
219.36	770.51	836.4	85.31	18332.23	18270.76
220.34	782.59	848.5	85.37	18596.15	18535.56
221.31	794.67	860.6	85.44	18860.10	18800.35
222.27	806.75	872.7	85.50	19124.06	19065.13
223.21	818.84	884.8	85.56	19388.05	19329.94
224.15	830.92	897.0	85.62	19652.06	19594.73
225.06	843.01	909.1	85.68	19916.09	19859.53
225.97	855.10	921.2	85.74	20180.15	20124.32
226.87	867.18	933.3	85.79	20444.22	20389.11
227.75	879.27	945.4	85.85	20708.31	20653.91
228.62	891.36	957.6	85.90	20972.41	20918.70
229.48	903.45	969.7	85.95	21236.54	21183.50
230.33	915.54	981.8	86.00	21500.68	21448.29
231.18	927.64	993.9	86.05	21764.83	21713.08
232.01	939.73	1006.1	86.10	22029.00	21977.88
232.83	951.82	1018.2	86.14	22293.19	22242.67
233.64	963.91	1030.3	86.19	22557.39	22507.46
234.44	976.01	1042.4	86.23	22821.61	22772.25
235.23	988.10	1054.5	86.27	23085.83	23037.05
236.01	1000.20	1066.7	86.32	23350.07	23301.84
236.79	1012.30	1078.8	86.36	23614.33	23566.64
237.55	1024.39	1090.9	86.40	23878.59	23831.43
238.31	1036.49	1103.0	86.44	24142.87	24096.23
239.06	1048.59	1115.1	86.48	24407.16	24361.02
239.80	1060.69	1127.3	86.51	24671.45	24625.81
240.53	1072.79	1139.4	86.55	24935.76	24890.61
241.26	1084.89	1151.5	86.59	25200.08	25155.41
241.98	1096.99	1163.6	86.62	25464.41	25420.19
242.69	1109.09	1175.7	86.66	25728.75	25684.99
243.39	1121.19	1187.9	86.69	25993.10	25949.78
244.09	1133.29	1200.0	86.73	26257.46	26214.58

S U P E R C A T

NO OF CATS= 1 HOLDING POWER= 2500.0

WTFT 21.8457 LENGTH OF LINE 1200.0 POINTS160 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	2500.00	0.00
12.10	.64	12.1	6.05	2513.99	264.79
24.06	2.54	24.2	11.96	2555.46	529.59
35.78	5.64	36.4	17.63	2623.17	794.38
47.14	9.85	48.5	22.96	2715.12	1059.17
58.08	15.06	60.6	27.91	2828.94	1323.97
68.55	21.15	72.7	32.44	2962.12	1588.76
78.54	28.02	84.8	36.55	3112.13	1853.56
88.03	35.56	97.0	40.28	3276.80	2118.35
97.04	43.66	109.1	43.63	3453.89	2383.14
105.58	52.26	121.2	46.65	3641.64	2647.94
113.69	61.27	133.3	49.36	3838.49	2912.73
121.38	70.64	145.5	51.81	4043.10	3177.52
128.69	80.31	157.6	54.01	4254.36	3442.32
135.63	90.24	169.7	56.01	4471.32	3707.11
142.25	100.39	181.8	57.81	4693.19	3971.91
148.56	110.75	193.9	59.46	4919.31	4236.70
154.58	121.27	206.1	60.95	5149.12	4501.49
160.33	131.93	218.2	62.32	5382.15	4766.29
165.84	142.73	230.3	63.58	5617.99	5031.08
171.13	153.64	242.4	64.73	5856.31	5295.87
176.20	164.65	254.5	65.79	6096.80	5560.67
181.07	175.74	266.7	66.77	6339.24	5825.46
185.76	186.92	278.8	67.68	6583.40	6090.25
190.28	198.17	290.9	68.53	6829.10	6355.05
194.64	209.48	303.0	69.31	7076.18	6619.84
198.85	220.84	315.1	70.04	7324.49	6884.64
202.92	232.26	327.3	70.73	7573.93	7149.43
206.85	243.73	339.4	71.37	7824.37	7414.22
210.67	255.23	351.5	71.97	8075.72	7679.02
214.36	266.78	363.6	72.53	8327.91	7943.81
217.94	278.36	375.8	73.06	8580.86	8208.60
221.42	289.97	387.9	73.56	8834.50	8473.40
224.81	301.61	400.0	74.03	9088.78	8738.19
228.09	313.27	412.1	74.48	9343.65	9002.99
231.29	324.96	424.2	74.90	9599.05	9267.78
234.41	336.68	436.4	75.30	9854.95	9532.57
237.45	348.41	448.5	75.69	10111.30	9797.37
240.40	360.17	460.6	76.05	10368.08	10062.16
243.29	371.94	472.7	76.39	10625.25	10326.95
246.11	383.73	484.8	76.72	10882.79	10591.75
248.86	395.53	497.0	77.03	11140.67	10856.54
251.55	407.35	509.1	77.33	11398.86	11121.33
254.18	419.19	521.2	77.62	11657.35	11386.13
256.75	431.03	533.3	77.89	11916.12	11650.92
259.27	442.89	545.4	78.15	12175.15	11915.72
261.73	454.75	557.6	78.40	12434.42	12180.51
264.14	466.63	569.7	78.64	12693.92	12445.31
266.50	478.52	581.8	78.87	12953.63	12710.10
268.82	490.42	593.9	79.09	13213.55	12974.89
271.09	502.33	606.1	79.31	13473.65	13239.69
273.32	514.24	618.2	79.51	13733.93	13504.48
275.50	526.16	630.3	79.71	13994.39	13769.27
277.65	538.09	642.4	79.90	14255.00	14034.07

279.76	553.03	654.5	80.38	14515.76	14298.86
281.63	561.97	666.7	80.26	14776.67	14563.65
283.86	573.92	678.8	80.43	15037.71	14828.45
285.86	585.88	690.9	80.60	15298.89	15093.24
287.82	597.84	703.0	80.75	15560.18	15358.03
289.75	609.80	715.1	80.91	15821.59	15622.83
291.65	621.78	727.3	81.06	16083.11	15887.62
293.52	633.75	739.4	81.20	16344.74	16152.42
295.36	645.73	751.5	81.34	16606.47	16417.21
297.17	657.72	763.6	81.48	16868.29	16682.00
298.95	669.71	775.7	81.61	17130.20	16946.81
300.71	681.70	787.9	81.74	17392.21	17211.59
302.44	693.70	800.0	81.86	17654.29	17476.38
304.14	705.70	812.1	81.98	17916.46	17741.18
305.82	717.70	824.2	82.10	18178.70	18005.97
307.48	729.71	836.4	82.21	18441.01	18270.76
309.11	741.72	848.5	82.32	18703.39	18535.56
310.72	753.73	860.6	82.43	18965.84	18800.35
312.30	765.75	872.7	82.53	19228.36	19065.15
313.87	777.77	884.8	82.63	19490.94	19329.94
315.41	789.79	897.0	82.73	19753.57	19594.73
316.94	801.82	909.1	82.83	20016.26	19859.53
318.44	813.85	921.2	82.92	20279.01	20124.32
319.93	825.87	933.3	83.01	20541.81	20389.11
321.39	837.91	945.4	83.10	20804.66	20653.91
322.84	849.94	957.6	83.18	21067.56	20918.70
324.27	861.98	969.7	83.27	21330.51	21183.50
325.68	874.02	981.8	83.35	21593.50	21448.29
327.07	886.06	993.9	83.43	21856.53	21713.08
328.45	898.10	1006.1	83.51	22119.61	21977.88
329.81	910.14	1018.2	83.59	22382.72	22242.67
331.16	922.19	1030.3	83.66	22645.88	22507.46
332.49	934.24	1042.4	83.73	22909.07	22772.26
333.81	946.29	1054.5	83.81	23172.31	23037.05
335.11	958.34	1066.7	83.88	23435.57	23301.84
336.39	970.39	1078.8	83.94	23698.87	23566.64
337.66	982.45	1090.9	84.01	23962.20	23831.43
338.92	994.50	1103.0	84.08	24225.57	24096.23
340.17	1006.56	1115.1	84.14	24488.96	24361.02
341.40	1018.62	1127.3	84.20	24752.39	24625.81
342.61	1030.68	1139.4	84.26	25015.84	24890.61
343.82	1042.74	1151.5	84.32	25279.32	25155.40
345.01	1054.80	1163.6	84.38	25542.83	25420.19
346.19	1066.86	1175.7	84.44	25806.37	25684.99
347.36	1078.93	1187.9	84.51	26069.93	25949.78
348.52	1090.99	1200.0	84.56	26333.51	26214.58

S U P E R C A T

NO OF CATS= 1 HOLDING POWER= 2750.0

MTFT 21.8457 LENGTH OF LINE 1300.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	2750.00	0.00
13.11	.68	13.1	5.96	2764.92	286.86
26.08	2.71	26.3	11.78	2809.21	573.72
38.78	6.02	39.4	17.38	2881.51	860.58
51.11	10.52	52.5	22.65	2979.78	1147.44
62.99	16.09	65.7	27.54	3101.57	1434.30
74.38	22.62	78.8	32.04	3244.21	1721.16
85.25	29.99	91.9	36.14	3405.09	2008.02
95.59	38.07	105.0	39.85	3581.73	2294.88
105.42	46.78	118.2	43.19	3771.99	2581.74
114.75	56.02	131.3	46.21	3973.83	2868.60
123.60	65.72	144.4	48.93	4185.62	3155.46
132.01	75.80	157.6	51.38	4405.91	3442.32
140.00	86.22	170.7	53.59	4633.43	3729.18
147.61	96.92	183.8	55.60	4867.35	4016.04
154.85	107.88	197.0	57.42	5106.61	4302.90
161.76	119.04	210.1	59.07	5350.55	4589.76
168.36	130.39	223.2	60.58	5598.56	4876.62
174.67	141.91	236.4	61.96	5850.13	5163.49
180.71	153.57	249.5	63.23	6104.81	5450.34
186.50	165.35	262.6	64.39	6362.23	5737.20
192.07	177.25	275.8	65.46	6622.07	6024.05
197.41	189.24	288.9	66.45	6884.05	6310.92
202.56	201.32	302.0	67.37	7147.95	6597.78
207.52	213.48	315.1	68.23	7413.55	6884.64
212.31	225.70	328.3	69.02	7680.68	7171.50
216.93	238.00	341.4	69.76	7949.19	7458.36
221.40	250.34	354.5	70.45	8218.93	7745.22
225.72	262.74	367.7	71.10	8489.80	8032.08
229.91	275.19	380.8	71.71	8761.69	8318.94
233.96	287.68	393.9	72.28	9034.50	8605.79
237.90	300.20	407.1	72.82	9308.16	8892.65
241.73	312.77	420.2	73.32	9582.59	9179.51
245.44	325.36	433.3	73.80	9857.73	9466.37
249.05	337.98	446.5	74.25	10133.51	9753.23
252.57	350.64	459.6	74.68	10409.90	10040.09
255.99	363.31	472.7	75.09	10686.84	10326.95
259.33	376.01	485.9	75.47	10964.28	10613.81
262.58	388.74	499.0	75.84	11242.21	10900.67
265.75	401.48	512.1	76.19	11520.56	11187.53
268.85	414.24	525.2	76.52	11799.33	11474.39
271.88	427.02	538.4	76.84	12078.49	11761.25
274.83	439.81	551.5	77.14	12357.97	12048.11
277.72	452.62	564.6	77.43	12637.80	12334.97
280.55	465.44	577.8	77.71	12917.94	12621.83
283.31	478.28	590.9	77.97	13198.36	12908.69
286.02	491.13	604.0	78.23	13479.06	13195.55
288.67	503.99	617.2	78.47	13760.01	13482.41
291.27	516.86	630.3	78.71	14041.23	13769.27
293.82	529.74	643.4	78.93	14322.62	14056.13
296.31	542.64	656.6	79.15	14604.24	14342.99
298.76	555.54	669.7	79.35	14886.07	14629.85
301.16	568.45	682.8	79.55	15168.03	14916.71
303.52	581.36	696.0	79.75	15450.28	15203.57
305.84	594.29	709.1	79.93	15732.64	15490.43

308.11	647.22	722.2	80.11	16015.16	15777.29
310.35	660.16	735.3	80.29	16297.84	16064.15
312.59	633.11	748.5	80.45	16580.65	16351.01
314.71	646.06	761.6	80.61	16863.61	16637.87
316.83	659.02	774.7	80.77	17146.69	16924.73
318.92	671.96	787.9	80.92	17429.93	17211.59
320.97	684.95	801.0	81.07	17713.22	17498.45
323.00	697.93	814.1	81.21	17996.66	17785.31
324.99	710.90	827.3	81.35	18280.20	18072.17
326.95	723.85	840.4	81.48	18563.85	18359.03
328.88	736.80	853.5	81.61	18847.59	18645.89
330.78	749.87	866.7	81.74	19131.43	18932.75
332.65	762.87	879.8	81.86	19415.35	19219.61
334.50	775.87	892.9	81.98	19699.36	19506.47
336.32	788.87	906.1	82.09	19983.45	19793.33
338.11	801.88	919.2	82.20	20267.62	20080.19
339.88	814.89	932.3	82.31	20551.86	20367.05
341.63	827.91	945.4	82.42	20836.18	20653.91
343.35	840.92	958.6	82.52	21120.56	20940.77
345.05	853.94	971.7	82.62	21405.01	21227.63
346.72	866.97	984.8	82.72	21689.53	21514.49
348.38	880.00	998.0	82.81	21974.10	21801.35
350.01	893.02	1011.1	82.90	22258.74	22088.21
351.62	906.06	1024.2	82.99	22543.43	22375.07
353.21	919.09	1037.4	83.08	22828.17	22661.93
354.79	932.13	1050.5	83.17	23112.97	22948.79
356.34	945.17	1063.6	83.25	23397.82	23235.65
357.87	958.21	1076.8	83.33	23682.71	23522.51
359.39	971.25	1089.9	83.41	23967.65	23809.37
360.89	984.30	1103.0	83.49	24252.64	24096.23
362.37	997.34	1116.2	83.57	24537.67	24383.09
363.83	1010.39	1129.3	83.64	24822.75	24669.95
365.28	1023.44	1142.4	83.71	25107.86	24956.81
366.71	1036.50	1155.5	83.78	25393.01	25243.67
368.12	1049.55	1168.7	83.85	25678.20	25530.52
369.52	1062.61	1181.8	83.92	25963.43	25817.38
370.90	1075.67	1194.9	83.99	26248.70	26104.24
372.27	1088.73	1208.1	84.05	26533.99	26391.10
373.62	1101.79	1221.2	84.11	26819.33	26677.96
374.96	1114.85	1234.3	84.18	27104.69	26964.82
376.29	1127.91	1247.5	84.24	27390.09	27251.68
377.61	1140.98	1260.6	84.30	27675.51	27538.54
378.90	1154.05	1273.7	84.36	27960.97	27825.40
380.18	1167.12	1286.9	84.41	28246.45	28112.26
381.46	1180.18	1300.0	84.47	28531.96	28399.12

S U P E R C A T

NO OF CATS= 1 HOLDING POWER= 3500.0

WTFT 21.8457 LENGTH OF LINE 1300.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	3500.00	0.00
13.12	.54	13.1	4.69	3511.74	286.85
26.15	2.14	26.3	9.31	3546.71	573.72
39.01	4.77	39.4	13.81	3604.25	860.59
51.63	8.39	52.5	18.15	3683.29	1147.44
63.94	12.93	65.7	22.28	3782.49	1434.30
75.91	18.32	78.8	26.19	3900.31	1721.16
87.50	24.50	91.9	29.84	4035.11	2008.02
98.69	31.37	105.0	33.25	4185.27	2294.88
109.46	38.87	118.2	36.41	4349.19	2581.74
119.82	46.94	131.3	39.34	4525.36	2868.61
129.78	55.50	144.4	42.04	4712.42	3155.46
139.33	64.50	157.6	44.52	4909.13	3442.32
148.51	73.90	170.7	46.92	5114.37	3729.19
157.31	83.64	183.8	48.93	5327.15	4016.04
165.77	93.68	197.0	50.87	5546.61	4302.90
173.89	104.00	210.1	52.67	5771.99	4589.76
181.70	114.56	223.2	54.33	6002.62	4876.62
189.21	125.33	236.4	55.87	6237.91	5163.48
196.44	136.29	249.5	57.29	6477.36	5450.34
203.40	147.42	262.6	58.61	6720.52	5737.20
210.12	158.70	275.8	59.84	6967.01	6024.06
216.60	170.12	288.9	60.99	7216.43	6310.92
222.86	181.67	302.0	62.05	7468.64	6597.78
228.91	193.32	315.1	63.05	7723.23	6884.64
234.77	205.07	328.3	63.99	7980.00	7171.51
240.44	216.92	341.4	64.86	8238.75	7458.35
245.93	228.85	354.5	65.68	8499.32	7745.22
251.25	240.85	367.7	66.45	8761.52	8032.08
256.42	252.92	380.8	67.18	9025.22	8318.94
261.44	265.05	393.9	67.87	9290.30	8605.79
266.32	277.25	407.1	68.52	9556.64	8892.65
271.06	289.49	420.2	69.13	9824.13	9179.51
275.68	301.78	433.3	69.71	10092.68	9466.37
280.17	314.12	446.5	70.26	10362.22	9753.23
284.55	326.50	459.6	70.78	10632.66	10040.09
288.82	338.92	472.7	71.28	10903.94	10326.95
292.98	351.37	485.9	71.75	11176.00	10613.81
297.04	363.86	499.0	72.20	11448.79	10900.67
301.01	376.38	512.1	72.63	11722.24	11187.53
304.89	388.92	525.2	73.04	11996.32	11474.39
308.67	401.50	538.4	73.43	12270.98	11761.25
312.38	414.10	551.5	73.80	12546.20	12048.11
316.00	426.72	564.6	74.16	12821.92	12334.97
319.55	439.36	577.8	74.50	13098.12	12621.83
323.02	452.02	590.9	74.83	13374.76	12908.69
326.42	464.71	604.0	75.14	13651.83	13195.55
329.75	477.41	617.2	75.45	13929.30	13482.41
333.02	490.13	630.3	75.74	14207.14	13769.27
336.23	502.86	643.4	76.02	14485.33	14056.13
339.37	515.62	656.6	76.29	14763.85	14342.99
342.45	528.37	669.7	76.55	15042.69	14629.85
345.48	541.15	682.8	76.80	15321.82	14916.71
348.45	553.94	696.0	77.04	15601.24	15203.57
351.37	566.74	709.1	77.27	15880.91	15490.43

354.24	579.50	722.2	77.49	16160.84	15777.29
357.06	592.38	735.3	77.71	16441.01	16064.15
359.83	605.42	748.5	77.92	16721.41	16351.01
362.56	618.66	761.6	78.12	17002.02	16637.87
365.24	630.92	774.7	78.32	17282.84	16924.73
367.88	643.78	787.9	78.51	17563.85	17211.59
370.47	656.65	801.0	78.69	17845.05	17498.45
373.03	669.53	814.1	78.87	18126.42	17785.31
375.54	682.42	827.3	79.04	18407.97	18072.17
378.02	695.32	840.4	79.21	18689.67	18359.03
380.46	708.22	853.5	79.37	18971.54	18645.89
382.87	721.13	866.7	79.53	19253.54	18932.75
385.24	734.04	879.8	79.68	19535.69	19219.61
387.57	746.97	892.9	79.83	19817.98	19506.47
389.88	759.89	906.1	79.97	20100.39	19793.33
392.15	772.83	919.2	80.11	20382.93	20080.19
394.39	785.77	932.3	80.25	20665.59	20367.05
396.59	798.71	945.4	80.38	20948.36	20653.91
398.77	811.66	958.6	80.51	21231.24	20940.77
400.92	824.61	971.7	80.64	21514.23	21227.63
403.05	837.57	984.8	80.76	21797.32	21514.49
405.14	850.53	998.0	80.88	22080.51	21801.35
407.21	863.50	1011.1	81.00	22363.79	22088.21
409.25	876.47	1024.2	81.11	22647.15	22375.07
411.27	889.45	1037.4	81.22	22930.61	22661.93
413.26	902.43	1050.5	81.33	23214.15	22948.79
415.23	915.41	1063.6	81.43	23497.77	23235.65
417.17	928.40	1076.8	81.54	23781.47	23522.51
419.09	941.39	1089.9	81.64	24065.24	23809.37
420.99	954.38	1103.0	81.74	24349.09	24096.23
422.87	967.38	1116.2	81.83	24633.00	24383.09
424.72	980.38	1129.3	81.93	24916.99	24669.95
426.56	993.38	1142.4	82.02	25201.03	24956.81
428.37	1006.38	1155.5	82.11	25485.15	25243.67
430.16	1019.39	1168.7	82.19	25769.32	25530.52
431.94	1032.40	1181.8	82.28	26053.55	25817.38
433.69	1045.42	1194.9	82.36	26337.84	26104.24
435.43	1058.43	1208.1	82.45	26622.18	26391.10
437.15	1071.45	1221.2	82.53	26906.57	26677.96
438.84	1084.47	1234.3	82.60	27191.02	26964.82
440.53	1097.49	1247.5	82.69	27475.52	27251.69
442.19	1110.52	1260.6	82.76	27760.07	27538.54
443.84	1123.55	1273.7	82.83	28044.65	27825.41
445.47	1136.58	1286.9	82.90	28329.30	28112.26
447.08	1149.61	1300.0	82.97	28613.99	28399.12

S U P E R C A T

NO OF CATS= 1 HOLDING POWER= 4500.0

WTFT 21.8427 LENGTH OF LINE 1300.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	4500.00	0.00
13.12	.42	13.1	3.65	4509.13	286.86
26.19	1.67	26.3	7.27	4536.43	573.72
39.16	3.73	39.4	10.83	4581.55	860.59
51.97	6.59	52.5	14.33	4643.99	1147.44
64.59	10.21	65.7	17.68	4723.05	1434.33
76.98	14.55	78.8	20.93	4817.92	1721.16
89.11	19.58	91.9	24.05	4927.69	2008.02
100.96	25.24	105.0	27.02	5051.38	2294.89
112.50	31.49	118.2	29.84	5188.00	2581.74
123.74	38.29	131.3	32.52	5336.56	2868.61
134.65	45.60	144.4	35.04	5496.08	3155.46
145.24	53.36	157.6	37.41	5665.65	3442.32
155.51	61.54	170.7	39.65	5844.36	3729.19
165.46	70.10	183.8	41.75	6031.46	4016.04
175.10	79.02	197.0	43.72	6226.15	4302.93
184.45	88.24	210.1	45.57	6427.74	4589.76
193.49	97.76	223.2	47.30	6635.62	4876.62
202.25	107.54	236.4	48.93	6849.20	5163.49
210.75	117.55	249.5	50.46	7067.97	5450.34
218.98	127.78	262.6	51.89	7291.46	5737.20
226.96	138.21	275.8	53.24	7519.25	6024.06
234.70	148.82	288.9	54.51	7750.98	6310.92
242.21	159.59	302.0	55.70	7986.28	6597.78
249.50	170.51	315.1	56.83	8224.85	6884.64
256.59	181.57	328.3	57.89	8466.42	7171.51
263.47	192.75	341.4	58.90	8710.74	7458.36
270.16	204.05	354.5	59.84	8957.59	7745.22
276.66	215.45	367.7	60.74	9206.75	8032.09
282.99	226.96	380.8	61.59	9458.05	8318.94
289.16	238.55	393.9	62.39	9711.32	8605.79
295.17	250.23	407.1	63.16	9966.41	8892.65
301.02	261.98	420.2	63.88	10223.18	9179.51
306.73	273.81	433.3	64.58	10481.52	9466.37
312.30	285.70	446.5	65.23	10741.30	9753.23
317.73	297.65	459.6	65.86	11002.43	10040.09
323.04	309.66	472.7	66.45	11264.81	10326.95
328.23	321.73	485.9	67.02	11528.36	10613.81
333.29	333.84	499.0	67.57	11792.93	10900.67
338.25	346.00	512.1	68.09	12058.64	11187.53
343.10	358.21	525.2	68.59	12325.25	11474.39
347.84	370.45	538.4	69.06	12592.74	11761.25
352.48	382.73	551.5	69.52	12861.07	12048.11
357.03	395.05	564.6	69.96	13130.18	12334.97
361.48	407.40	577.8	70.39	13400.02	12621.83
365.85	419.79	590.9	70.78	13670.56	12908.69
370.13	432.20	604.0	71.17	13941.76	13195.55
374.33	444.64	617.2	71.54	14213.57	13482.41
378.45	457.11	630.3	71.90	14485.95	13769.27
382.49	469.61	643.4	72.25	14758.84	14056.13
386.45	482.12	656.6	72.58	15032.35	14342.99
390.35	494.66	669.7	72.90	15306.29	14629.85
394.18	507.23	682.8	73.21	15580.73	14916.71
397.93	519.81	696.0	73.51	15855.55	15203.57
401.63	532.41	709.1	73.80	16130.82	15490.43

405.26	545.03	722.2	74.09	16406.49	15777.29
408.85	557.66	735.3	74.35	16682.53	16064.15
412.35	570.32	748.5	74.61	16958.94	16351.01
415.80	582.98	761.6	74.87	17235.68	16637.87
419.20	595.67	774.7	75.11	17512.75	16924.73
422.55	608.36	787.9	75.35	17790.13	17211.59
425.85	621.07	801.0	75.58	18067.81	17498.45
429.09	633.80	814.1	75.81	18345.77	17785.31
432.29	646.53	827.3	76.02	18624.00	18072.17
435.44	659.28	840.4	76.23	18902.49	18359.03
438.54	672.04	853.5	76.43	19181.22	18645.89
441.60	684.81	866.7	76.63	19460.19	18932.75
444.62	697.59	879.8	76.82	19739.39	19219.61
447.59	710.38	892.9	77.01	20018.80	19506.47
450.52	723.18	906.1	77.19	20298.42	19793.33
453.41	735.99	919.2	77.37	20578.24	20080.19
456.26	748.81	932.3	77.54	20858.25	20367.05
459.08	761.63	945.4	77.71	21138.45	20653.91
461.85	774.47	958.6	77.87	21418.82	20940.77
464.60	787.31	971.7	78.03	21699.36	21227.63
467.30	800.16	984.8	78.19	21980.06	21514.49
469.97	813.02	998.0	78.34	22260.92	21801.35
472.61	825.88	1011.1	78.48	22541.94	22088.21
475.22	838.75	1024.2	78.63	22823.09	22375.07
477.79	851.63	1037.4	78.77	23104.39	22661.93
480.33	864.51	1050.5	78.91	23385.82	22948.79
482.84	877.40	1063.6	79.04	23667.39	23235.65
485.32	890.29	1076.8	79.17	23949.08	23522.51
487.76	903.19	1089.9	79.30	24230.89	23809.37
490.20	916.10	1103.0	79.42	24512.81	24096.23
492.60	929.01	1116.2	79.54	24794.86	24383.09
494.97	941.92	1129.3	79.66	25077.01	24669.95
497.31	954.85	1142.4	79.78	25359.26	24956.81
499.63	967.77	1155.5	79.89	25641.62	25243.67
501.92	980.70	1168.7	80.00	25924.08	25530.52
504.19	993.63	1181.8	80.11	26206.63	25817.38
506.43	1006.57	1194.9	80.22	26489.27	26104.24
508.65	1019.51	1208.1	80.32	26772.01	26391.10
510.84	1032.46	1221.2	80.43	27054.83	26677.96
513.02	1045.41	1234.3	80.53	27337.73	26964.82
515.17	1058.37	1247.5	80.62	27620.72	27251.68
517.30	1071.32	1260.6	80.72	27903.79	27538.54
519.40	1084.28	1273.7	80.81	28186.93	27825.40
521.49	1097.25	1286.9	80.91	28470.15	28112.25
523.55	1110.22	1300.0	81.00	28753.44	28399.12

S U P E R C A T

NO OF CATS= 1 HOLDING POWER= 4750.0

WTFT 21.8457 LENGTH OF LINE 1300.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	4750.00	0.00
13.12	.40	13.1	3.46	4758.03	286.86
26.29	1.58	26.3	6.89	4784.52	573.72
39.18	3.54	39.4	10.27	4827.33	860.58
52.03	6.25	52.5	13.58	4886.63	1147.44
64.70	9.70	65.7	16.80	4961.83	1434.31
77.16	13.83	78.8	19.92	5052.22	1721.16
89.38	18.63	91.9	22.92	5157.03	2008.02
101.34	24.05	105.0	25.79	5275.32	2294.88
113.02	30.04	119.2	28.53	5406.28	2581.74
124.41	36.57	131.3	31.13	5549.03	2868.60
135.50	43.60	144.4	33.60	5702.58	3155.46
146.29	51.09	157.6	35.93	5866.19	3442.32
156.77	59.00	170.7	38.14	6038.98	3729.18
166.94	67.30	183.8	40.21	6220.21	4016.04
176.82	75.95	197.0	42.17	6409.17	4302.91
186.41	84.92	210.1	44.02	6605.18	4589.76
195.71	94.19	223.2	45.75	6807.64	4876.62
204.74	103.73	236.4	47.39	7015.98	5163.49
213.50	113.51	249.5	48.93	7229.71	5450.34
222.00	123.52	262.6	50.38	7448.35	5737.21
230.25	133.73	275.8	51.74	7671.49	6024.06
238.26	144.14	288.9	53.03	7898.74	6310.92
246.04	154.71	302.0	54.25	8129.77	6597.78
253.61	165.44	315.1	55.40	8364.25	6884.64
260.96	176.32	328.3	56.48	8601.91	7171.51
268.11	187.34	341.4	57.51	8842.49	7458.36
275.07	198.47	354.5	58.48	9085.75	7745.22
281.84	209.72	367.7	59.40	9331.49	8032.08
288.44	221.07	380.8	60.27	9579.52	8318.94
319.03	279.16	446.5	64.03	10848.41	9753.23
324.71	291.00	459.6	64.68	11107.02	10040.09
330.26	302.96	472.7	65.30	11366.99	10326.95
335.68	314.85	485.9	65.89	11628.22	10613.81
340.99	326.67	499.0	66.45	11890.63	10900.67
346.18	338.93	512.1	66.99	12154.15	11187.53
351.25	352.64	525.2	67.51	12418.78	11474.39
356.22	363.19	538.4	68.01	12684.23	11761.25
361.09	375.39	551.5	68.48	12950.66	12048.11
365.86	387.63	564.6	68.94	13217.94	12334.97
370.53	399.90	577.8	69.38	13486.04	12621.83
375.11	412.20	590.9	69.80	13754.88	12908.69
379.60	424.54	604.0	70.20	14024.45	13195.55
384.00	436.91	617.2	70.59	14294.68	13482.41
388.33	449.31	630.3	70.97	14565.55	13769.27
392.57	461.74	643.4	71.33	14837.03	14056.13
396.73	474.19	656.6	71.68	15109.07	14342.99
400.80	486.67	669.7	72.01	15381.65	14629.85
404.85	499.17	682.8	72.34	15654.74	14916.71
408.80	511.69	696.0	72.65	15928.31	15203.57
412.68	524.24	709.1	72.95	16202.34	15490.43
416.50	536.80	722.2	73.24	16476.81	15777.29
420.25	549.39	735.3	73.53	16751.73	16064.15
423.94	561.99	748.5	73.80	17026.98	16351.01
427.58	574.60	761.6	74.07	17302.64	16637.87

431.15	587.24	774.7	74.32	17578.65	16924.73
434.67	599.89	787.9	74.57	17855.01	17211.59
438.14	612.56	801.0	74.81	18131.69	17498.45
441.55	625.25	814.1	75.05	18408.69	17785.31
444.92	637.93	827.3	75.27	18685.98	18072.17
448.23	650.63	840.4	75.49	18963.56	18359.03
451.50	663.35	853.5	75.71	19241.41	18645.89
454.71	676.08	866.7	75.92	19519.52	18932.75
457.89	688.83	879.8	76.12	19797.87	19219.61
461.02	701.58	892.9	76.31	20076.47	19506.47
464.10	714.34	906.1	76.51	20355.30	19793.33
467.14	727.12	919.2	76.69	20634.35	20080.19
470.15	739.90	932.3	76.87	20913.61	20367.05
473.11	752.69	945.4	77.05	21193.07	20653.91
476.03	765.49	958.6	77.22	21472.73	20940.77
478.92	778.30	971.7	77.39	21752.58	21227.63
481.77	791.12	984.8	77.55	22032.60	21514.49
484.58	803.95	998.0	77.71	22312.80	21801.35
487.36	816.78	1011.1	77.86	22593.17	22088.21
490.10	829.62	1024.2	78.01	22873.70	22375.07
492.81	842.47	1037.4	78.16	23154.38	22661.93
495.49	855.33	1050.5	78.31	23435.21	22948.79
498.14	868.19	1063.6	78.45	23716.19	23235.65
500.75	881.06	1076.8	78.58	23997.31	23522.51
503.34	893.93	1089.9	78.72	24278.56	23809.37
505.89	906.81	1103.0	78.85	24559.94	24096.23
508.41	919.70	1116.2	78.96	24841.44	24383.09
510.91	932.59	1129.3	79.10	25123.07	24669.95
513.38	945.49	1142.4	79.22	25404.81	24956.81
515.82	958.39	1155.5	79.34	25686.67	25243.67
518.24	971.30	1168.7	79.46	25968.64	25530.52
520.63	984.21	1181.8	79.58	26250.71	25817.38
522.99	997.12	1194.9	79.69	26532.89	26104.24
525.33	1010.05	1208.1	79.80	26815.16	26391.10
527.64	1022.97	1221.2	79.90	27097.53	26677.96
529.93	1035.90	1234.3	80.01	27380.00	26964.82
532.20	1048.84	1247.5	80.11	27662.55	27251.68
534.44	1061.77	1260.6	80.21	27945.19	27538.54
536.66	1074.72	1273.7	80.31	28227.92	27825.40
538.86	1087.66	1286.9	80.41	28510.73	28112.26
541.04	1100.61	1300.0	80.50	28793.62	28399.12

S J P E R C A T

NO OF CATS= 1 HOLDING POWER= 5500.0

WTFT 21.8457 LENGTH OF LINE 1300.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	5500.00	0.00
13.13	.34	13.1	2.99	5507.48	286.85
26.21	1.37	26.3	5.96	5529.84	573.72
39.23	3.00	39.4	8.89	5566.92	860.58
52.15	5.42	52.5	11.78	5618.42	1147.44
64.93	8.42	65.7	14.62	5683.94	1434.30
77.55	12.04	78.8	17.38	5763.02	1721.15
89.99	16.25	91.9	20.06	5855.10	2008.02
102.22	21.04	105.0	22.65	5959.57	2294.88
114.22	26.36	118.2	25.15	6075.80	2581.74
125.99	32.19	131.3	27.54	6203.13	2868.61
137.50	38.49	144.4	29.84	6340.89	3155.46
148.76	45.25	157.6	32.04	6488.42	3442.32
159.76	52.42	170.7	34.14	6645.06	3729.19
170.50	59.97	183.8	36.14	6810.18	4016.04
180.97	67.85	197.0	38.04	6983.19	4302.91
191.19	76.15	210.1	39.85	7163.51	4589.75
201.14	84.71	223.2	41.56	7350.61	4876.62
210.84	93.56	236.4	43.19	7543.97	5163.49
220.29	102.68	249.5	44.74	7743.14	5450.34
229.50	112.04	262.6	46.21	7947.67	5737.20
238.47	121.63	275.8	47.60	8157.16	6024.06
247.21	131.43	288.9	48.93	8371.24	6310.92
255.72	141.43	302.0	50.18	8589.57	6597.79
264.02	151.60	315.1	51.38	8811.82	6884.64
272.12	161.94	328.3	52.51	9037.72	7171.51
280.01	172.44	341.4	53.59	9266.93	7458.36
287.71	183.07	354.5	54.62	9499.39	7745.22
295.22	193.85	367.7	55.60	9734.69	8032.09
302.55	204.74	380.8	56.53	9972.70	8318.94
309.70	215.75	393.9	57.42	10213.21	8605.79
316.69	226.87	407.1	58.26	10456.07	8892.65
323.52	238.08	420.2	59.07	10701.11	9179.51
330.19	249.39	433.3	59.84	10948.16	9466.37
336.71	260.79	446.5	60.58	11197.12	9753.23
343.09	272.27	459.6	61.29	11447.86	10040.09
349.33	283.82	472.7	61.96	11700.25	10326.95
355.44	295.45	485.9	62.61	11954.21	10613.81
361.42	307.14	499.0	63.23	12209.61	10900.67
367.27	318.89	512.1	63.82	12466.33	11187.53
373.01	330.70	525.2	64.39	12724.45	11474.39
378.62	342.57	538.4	64.94	12983.72	11761.25
384.13	354.49	551.5	65.46	13244.13	12048.11
389.53	366.46	564.6	65.97	13505.61	12334.97
394.83	378.48	577.8	66.45	13768.10	12621.83
400.02	390.54	590.9	66.92	14031.55	12908.69
405.14	402.64	604.0	67.37	14295.89	13195.55
410.13	414.78	617.2	67.81	14561.09	13482.41
415.04	426.95	630.3	68.23	14827.10	13769.27
419.87	439.17	643.4	68.63	15093.87	14056.13
424.61	451.41	656.6	69.02	15361.36	14342.99
429.28	463.69	669.7	69.40	15629.54	14629.85
433.86	475.99	682.8	69.76	15898.37	14916.71
438.36	488.33	696.0	70.11	16167.83	15203.57
442.79	500.69	709.1	70.45	16437.87	15490.43

447.15	513.07	722.2	70.78	16704.47	15777.29
451.44	525.49	735.3	71.10	16979.60	16064.15
455.06	537.92	748.5	71.41	17251.25	16351.01
459.81	550.38	761.6	71.71	17523.38	16637.97
463.90	562.86	774.7	72.00	17795.97	16924.73
467.93	575.35	787.9	72.28	18069.00	17211.59
471.90	587.87	801.0	72.55	18342.46	17498.45
475.80	600.41	814.1	72.82	18616.32	17785.31
479.65	612.96	827.3	73.07	18890.56	18072.17
483.45	625.53	840.4	73.32	19165.18	18359.03
487.19	638.12	853.5	73.57	19440.14	18645.89
490.88	650.72	866.7	73.80	19715.45	18932.75
494.52	663.34	879.8	74.03	19991.08	19219.61
498.11	675.97	892.9	74.25	20267.03	19506.47
501.65	688.61	906.1	74.47	20543.27	19793.33
505.14	701.27	919.2	74.68	20819.80	20080.19
508.58	713.94	932.3	74.89	21096.60	20367.05
511.99	726.63	945.4	75.09	21373.67	20653.91
515.34	739.32	958.6	75.28	21651.00	20940.77
518.66	752.03	971.7	75.47	21928.57	21227.63
521.93	764.74	984.8	75.66	22206.38	21514.49
525.16	777.47	998.0	75.84	22484.41	21801.35
528.35	790.21	1011.1	76.02	22762.66	22088.21
531.51	802.96	1024.2	76.19	23041.13	22375.07
534.62	815.71	1037.4	76.36	23319.80	22661.93
537.70	828.48	1050.5	76.52	23598.66	22948.79
540.74	841.25	1063.6	76.68	23877.71	23235.65
543.75	854.03	1076.8	76.84	24156.95	23522.51
546.72	866.82	1089.9	76.99	24436.36	23809.37
549.66	879.62	1103.0	77.14	24715.93	24096.23
552.57	892.43	1116.2	77.29	24995.70	24383.09
555.44	905.24	1129.3	77.43	25275.60	24669.95
558.28	918.06	1142.4	77.57	25555.67	24956.81
561.09	930.89	1155.5	77.71	25835.88	25243.67
563.87	943.72	1168.7	77.84	26116.23	25530.53
566.63	956.56	1181.8	77.97	26396.73	25817.39
569.35	969.41	1194.9	78.10	26677.36	26104.24
572.04	982.26	1208.1	78.23	26958.12	26391.10
574.71	995.12	1221.2	78.35	27239.01	26677.96
577.34	1007.98	1234.3	78.47	27520.02	26964.82
579.95	1020.85	1247.5	78.59	27801.16	27251.68
582.54	1033.72	1260.6	78.71	28082.40	27538.54
585.10	1046.60	1273.7	78.82	28363.76	27825.40
587.63	1059.49	1286.9	78.93	28645.23	28112.26
590.14	1072.38	1300.0	79.04	28926.81	28399.12

S U P E R C A T

NO OF CATS= 1 HOLDING POWER= 10000.0

WTFT 21.8457 LENGTH OF LINE 1500.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	10000.00	0.00
15.15	.25	15.2	1.90	10005.48	330.99
30.28	1.00	30.3	3.79	10021.89	661.99
45.38	2.25	45.5	5.67	10049.18	992.99
60.43	3.99	60.6	7.54	10087.26	1323.97
75.42	6.23	75.8	9.40	10136.02	1654.95
90.32	8.94	90.9	11.23	10195.29	1985.93
105.13	12.13	106.1	13.04	10264.90	2316.94
119.84	15.78	121.2	14.83	10344.64	2647.94
134.42	19.88	136.4	16.59	10434.27	2978.93
148.88	24.42	151.5	18.31	10533.55	3309.92
163.19	29.40	166.7	20.01	10642.19	3640.91
177.35	34.79	181.8	21.66	10759.93	3971.91
191.35	40.58	197.0	23.28	10886.46	4302.91
205.18	46.76	212.1	24.86	11021.49	4633.89
218.84	53.31	227.3	26.40	11164.68	4964.89
232.32	60.23	242.4	27.91	11315.75	5295.87
245.62	67.49	257.6	29.37	11474.39	5626.87
258.73	75.08	272.7	30.79	11640.29	5957.85
271.65	83.00	287.9	32.17	11813.11	6288.85
284.38	91.21	303.0	33.50	11992.59	6619.84
296.92	99.72	318.2	34.80	12178.43	6950.83
309.26	108.52	333.3	36.06	12370.33	7281.83
321.41	117.55	348.5	37.28	12568.02	7612.82
333.37	126.85	363.6	38.46	12771.22	7943.81
345.14	136.40	378.8	39.61	12979.69	8274.81
356.72	146.17	393.9	40.71	13193.17	8605.79
368.11	156.16	409.1	41.79	13411.42	8936.79
379.31	166.36	424.2	42.82	13634.21	9267.78
390.34	176.75	439.4	43.83	13861.33	9598.77
401.18	187.34	454.5	44.80	14092.56	9929.75
411.84	198.10	469.7	45.74	14327.70	10260.76
422.33	209.04	484.8	46.65	14566.53	10591.75
432.64	220.13	500.0	47.53	14808.99	10922.74
442.79	231.39	515.1	48.38	15054.73	11253.73
452.77	242.78	530.3	49.20	15303.73	11584.72
462.59	254.32	545.4	50.00	15555.84	11915.72
472.25	265.99	560.6	50.77	15810.81	12246.71
481.76	277.79	575.8	51.51	16068.56	12577.71
491.11	289.71	590.9	52.24	16328.94	12908.69
500.32	301.75	606.1	52.94	16591.84	13239.69
509.38	313.89	621.2	53.61	16857.14	13570.68
518.30	326.14	636.4	54.27	17124.73	13901.67
527.07	338.49	651.5	54.91	17394.50	14232.65
535.72	350.93	666.7	55.52	17666.35	14563.65
544.23	363.47	681.8	56.12	17940.19	14894.65
552.61	376.09	697.0	56.70	18215.93	15225.64
560.86	388.79	712.1	57.27	18493.49	15556.63
569.00	401.58	727.3	57.81	18772.76	15887.62
577.01	414.44	742.4	58.34	19053.73	16218.61
584.90	427.37	757.6	58.86	19336.22	16549.61
592.68	440.37	772.7	59.36	19620.26	16880.61
600.35	453.44	787.9	59.84	19905.75	17211.59
607.90	466.57	803.0	60.32	20192.63	17542.58
615.35	479.77	818.2	60.77	20480.84	17873.57

622.70	493.62	833.3	61.22	20770.32	18204.57
629.94	506.33	848.5	61.65	21061.03	18535.56
637.19	519.69	863.6	62.07	21352.91	18866.55
644.14	533.10	878.8	62.48	21645.91	19197.54
651.09	546.56	893.9	62.88	21940.03	19528.53
657.95	560.07	909.1	63.27	22235.13	19859.53
664.72	573.63	924.2	63.65	22531.25	20190.52
671.40	587.22	939.4	64.02	22828.32	20521.51
677.99	600.87	954.5	64.38	23126.32	20852.50
684.50	614.55	969.7	64.73	23425.21	21183.50
690.93	628.27	984.8	65.07	23724.95	21514.49
697.28	642.03	1000.0	65.40	24025.51	21845.49
703.54	655.82	1015.1	65.73	24326.86	22176.47
709.73	669.65	1030.3	66.04	24628.96	22507.46
715.85	683.51	1045.4	66.35	24931.81	22838.46
721.89	697.41	1060.6	66.65	25235.36	23169.45
727.86	711.33	1075.7	66.95	25539.59	23500.44
733.75	725.29	1090.9	67.24	25844.48	23831.43
739.58	739.28	1106.0	67.52	26150.00	24162.42
745.34	753.29	1121.2	67.79	26456.14	24493.42
751.04	767.33	1136.4	68.06	26762.87	24824.41
756.66	781.40	1151.5	68.32	27070.17	25155.40
762.23	795.49	1166.7	68.58	27378.02	25486.39
767.73	809.61	1181.8	68.83	27686.41	25817.39
773.18	823.75	1197.0	69.07	27995.31	26148.38
778.56	837.91	1212.1	69.31	28304.72	26479.37
783.88	852.09	1227.3	69.54	28614.60	26810.36
789.15	866.30	1242.4	69.77	28924.96	27141.35
794.36	880.53	1257.6	70.00	29235.76	27472.35
799.51	894.78	1272.7	70.22	29547.01	27803.34
804.61	909.04	1287.9	70.43	29858.69	28134.33
809.66	923.33	1303.0	70.64	30170.76	28465.32
814.66	937.63	1318.2	70.85	30483.24	28796.31
819.60	951.95	1333.3	71.05	30796.10	29127.31
824.50	966.29	1348.5	71.25	31109.34	29458.30
829.34	980.65	1363.6	71.44	31422.95	29789.29
834.14	995.02	1378.8	71.63	31736.91	30120.28
838.89	1009.41	1393.9	71.82	32051.21	30451.27
843.60	1023.81	1409.1	72.00	32365.84	30782.27
848.26	1038.23	1424.2	72.18	32680.80	31113.26
852.87	1052.66	1439.4	72.36	32996.07	31444.25
857.44	1067.10	1454.5	72.53	33311.65	31775.24
861.97	1081.56	1469.7	72.70	33627.52	32106.23
866.45	1096.04	1484.8	72.87	33943.68	32437.23
870.89	1110.52	1500.0	73.03	34260.13	32768.22

S U P E R C A T

NO OF CATS= 1 HOLDING POWER= 10800.0

WTFT 21.8457 LENGTH OF LINE 1500.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	10800.00	0.00
15.15	.23	15.2	1.76	10805.07	330.99
30.29	.93	30.3	3.51	10820.27	661.99
45.39	2.09	45.5	5.25	10845.55	992.99
60.45	3.70	60.6	6.99	10880.85	1323.97
75.46	5.77	75.8	8.71	10926.06	1654.96
90.40	8.29	90.9	10.42	10981.07	1985.95
105.26	11.25	106.1	12.11	11045.73	2316.94
120.03	14.64	121.2	13.78	11119.87	2647.94
134.69	18.46	136.4	15.42	11203.30	2978.93
149.24	22.70	151.5	17.04	11295.82	3309.92
163.66	27.34	166.7	18.63	11397.21	3640.91
177.95	32.37	181.8	20.19	11507.22	3971.91
192.10	37.79	197.0	21.72	11625.62	4302.91
206.10	43.59	212.1	23.22	11752.15	4633.89
219.94	49.74	227.3	24.69	11886.55	4964.89
233.63	56.24	242.4	26.12	12028.56	5295.87
247.15	63.07	257.6	27.52	12177.92	5626.87
260.50	70.24	272.7	28.88	12334.35	5957.86
273.68	77.71	287.9	30.21	12497.59	6288.85
286.69	85.48	303.0	31.51	12667.37	6619.84
299.52	93.54	318.2	32.77	12843.45	6950.83
312.17	101.88	333.3	33.99	13025.55	7281.83
324.64	110.48	348.5	35.18	13213.44	7612.82
336.94	119.33	363.6	36.34	13406.87	7943.81
349.05	128.43	378.8	37.46	13605.60	8274.81
360.99	137.76	393.9	38.55	13809.41	8605.79
372.75	147.31	409.1	39.61	14018.07	8936.79
384.34	157.07	424.2	40.63	14231.36	9267.79
395.75	167.04	439.4	41.63	14449.10	9598.77
406.99	177.20	454.5	42.60	14671.07	9929.76
418.06	187.55	469.7	43.53	14897.09	10260.76
428.96	198.07	484.8	44.44	15126.97	10591.75
439.69	208.76	500.0	45.32	15360.54	10922.74
450.26	219.62	515.1	46.18	15597.64	11253.73
460.67	230.62	530.3	47.01	15838.11	11584.72
470.93	241.78	545.4	47.81	16081.80	11915.72
481.03	253.07	560.6	48.59	16328.56	12246.71
490.97	264.50	575.8	49.35	16579.26	12577.71
500.77	276.06	590.9	50.08	16830.76	12908.69
510.42	287.74	606.1	50.79	17085.94	13239.68
519.92	299.54	621.2	51.49	17343.68	13570.68
529.29	311.45	636.4	52.16	17603.87	13901.67
538.51	323.47	651.5	52.81	17866.41	14232.66
547.61	335.59	666.7	53.44	18131.19	14563.65
556.57	347.81	681.8	54.05	18398.11	14894.65
565.40	360.12	697.0	54.65	18667.08	15225.64
574.10	372.52	712.1	55.23	18938.02	15556.63
582.68	385.01	727.3	55.79	19210.84	15887.62
591.14	397.58	742.4	56.34	19485.47	16218.61
599.47	410.23	757.6	56.87	19761.82	16549.61
607.70	422.96	772.7	57.39	20039.82	16880.60
615.81	435.76	787.9	57.89	20319.42	17211.59
623.80	448.63	803.0	58.38	20600.54	17542.59
631.69	461.56	818.2	58.86	20883.12	17873.57

639.48	474.56	833.3	59.32	21167.10	18204.57
647.16	487.62	848.5	59.77	21452.43	18535.56
654.73	500.74	863.6	60.21	21739.06	18866.55
662.21	513.92	878.8	60.64	22026.93	19197.54
669.59	527.15	893.9	61.06	22316.00	19528.53
676.88	540.44	909.1	61.46	22606.21	19859.53
684.07	553.77	924.2	61.86	22897.53	20190.52
691.17	567.16	939.4	62.24	23189.92	20521.51
698.18	580.59	954.5	62.62	23483.33	20852.51
705.11	594.06	969.7	62.99	23777.73	21183.50
711.95	607.58	984.8	63.34	24073.08	21514.49
718.70	621.14	1000.0	63.69	24369.34	21845.49
725.38	634.75	1015.1	64.03	24666.49	22176.47
731.97	648.39	1030.3	64.37	24964.49	22507.46
738.49	662.07	1045.4	64.69	25263.31	22838.45
744.93	675.78	1060.6	65.01	25562.93	23169.45
751.29	689.53	1075.7	65.32	25863.31	23500.44
757.58	703.32	1090.9	65.62	26164.43	23831.43
763.80	717.13	1106.0	65.92	26466.26	24162.42
769.95	730.98	1121.2	66.21	26768.78	24493.42
776.02	744.86	1136.4	66.49	27071.96	24824.41
782.03	758.77	1151.5	66.76	27375.80	25155.40
787.98	772.70	1166.7	67.03	27680.25	25486.39
793.86	786.67	1181.8	67.30	27985.31	25817.38
799.67	800.66	1197.0	67.56	28290.95	26148.38
805.43	814.68	1212.1	67.81	28597.15	26479.37
811.12	828.72	1227.3	68.06	28903.90	26810.36
816.75	842.78	1242.4	68.30	29211.19	27141.35
822.32	856.87	1257.6	68.54	29518.97	27472.35
827.84	870.98	1272.7	68.77	29827.26	27803.34
833.30	885.12	1287.9	69.00	30136.03	28134.33
838.70	899.27	1303.0	69.22	30445.27	28465.32
844.04	913.45	1318.2	69.44	30754.96	28796.31
849.34	927.65	1333.3	69.66	31065.09	29127.31
854.58	941.86	1348.5	69.87	31375.65	29458.31
859.77	956.10	1363.6	70.07	31686.62	29789.29
864.91	970.35	1378.8	70.27	31997.99	30120.28
870.00	984.62	1393.9	70.47	32309.75	30451.27
875.04	998.91	1409.1	70.67	32621.89	30782.27
880.03	1013.22	1424.2	70.86	32934.43	31113.26
884.98	1027.54	1439.4	71.04	33247.27	31444.25
889.87	1041.87	1454.5	71.23	33560.43	31775.24
894.73	1056.23	1469.7	71.41	33874.04	32106.23
899.54	1070.60	1484.8	71.58	34187.92	32437.23
904.30	1084.98	1500.0	71.76	34502.12	32768.22

SUPERCAT

NO OF CATS= 1 HOLDING POWER= 11250.0

WTFT 21.8457 LENGTH OF LINE 1540.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	11250.00	0.00
15.15	.22	15.2	1.69	11254.87	330.99
30.29	.89	30.3	3.37	11269.46	661.98
45.40	2.00	45.5	5.04	11293.74	992.99
60.47	3.55	60.6	6.71	11327.64	1323.97
75.49	5.54	75.6	8.37	11371.08	1654.95
90.44	7.96	90.9	10.01	11423.94	1985.95
105.32	10.81	106.1	11.64	11486.11	2316.94
120.12	14.07	121.2	13.24	11557.42	2647.94
134.82	17.75	136.4	14.83	11637.72	2978.93
149.41	21.83	151.5	16.39	11726.81	3309.92
163.88	26.30	166.7	17.93	11824.50	3640.91
178.24	31.15	181.8	19.45	11930.57	3971.91
192.46	36.38	197.0	20.93	12044.81	4302.90
206.54	41.98	212.1	22.39	12166.98	4633.89
220.47	47.92	227.3	23.81	12296.85	4964.88
234.26	54.21	242.4	25.21	12434.19	5295.87
247.89	60.82	257.6	26.57	12578.72	5626.87
261.36	67.76	272.7	27.91	12730.22	5957.86
274.67	75.04	287.9	29.21	12888.45	6288.85
287.81	82.54	303.0	30.47	13053.15	6619.84
300.78	90.37	318.2	31.71	13224.09	6950.83
313.59	98.46	333.3	32.91	13401.03	7281.83
326.22	106.83	348.5	34.09	13583.72	7612.82
338.68	115.44	363.6	35.23	13771.95	7943.81
350.98	124.30	378.8	36.34	13965.49	8274.80
363.09	133.40	393.9	37.41	14164.12	8605.79
375.04	142.71	409.1	38.46	14367.63	8936.79
386.82	152.24	424.2	39.48	14575.81	9267.79
398.43	161.98	439.4	40.47	14788.47	9598.77
409.88	171.91	454.5	41.43	15005.42	9929.76
421.15	182.03	469.7	42.37	15226.48	10260.76
432.26	192.32	484.8	43.27	15451.46	10591.75
443.22	202.80	500.0	44.15	15680.20	10922.74
454.01	213.43	515.1	45.01	15912.54	11253.73
464.64	224.22	530.3	45.84	16146.32	11584.72
475.12	235.17	545.4	46.65	16387.40	11915.72
485.44	246.26	560.6	47.43	16629.62	12246.71
495.62	257.48	575.8	48.19	16874.86	12577.70
505.65	268.84	590.9	48.93	17122.99	12908.69
515.53	280.32	606.1	49.64	17373.88	13239.69
525.27	291.93	621.2	50.34	17627.42	13570.68
534.87	303.65	636.4	51.02	17883.48	13901.67
544.33	315.48	651.5	51.68	18141.97	14232.66
553.66	327.42	666.7	52.31	18402.79	14563.65
562.86	339.46	681.8	52.94	18665.82	14894.65
571.93	351.60	697.0	53.54	18930.99	15225.64
580.87	363.83	712.1	54.13	19198.21	15556.63
589.68	376.16	727.3	54.70	19467.38	15887.62
598.38	388.58	742.4	55.25	19738.44	16218.61
606.96	401.05	757.6	55.79	20011.30	16549.61
615.42	413.62	772.7	56.32	20285.88	16880.60
623.76	426.27	787.9	56.83	20562.13	17211.59
632.00	438.99	803.0	57.33	20839.98	17542.59
640.12	451.78	818.2	57.81	21119.35	17873.57

648.14	464.63	833.3	58.28	21400.20	18[illegible]4.57
656.05	477.55	848.5	58.74	21682.47	18535.56
663.66	490.54	863.6	59.19	21966.09	18866.55
671.57	503.58	878.8	59.63	22251.03	19197.54
679.18	516.68	893.9	60.05	22537.22	19528.53
686.70	529.84	909.1	60.47	22824.62	19859.53
694.13	543.04	924.2	60.87	23113.19	20190.52
701.45	556.31	939.4	61.27	23402.88	20521.51
708.69	569.62	954.5	61.65	23693.66	20852.50
715.84	582.97	969.7	62.03	23985.47	21183.50
722.90	596.38	984.8	62.39	24278.30	21514.49
729.88	609.83	1000.0	62.75	24572.09	21845.48
736.78	623.32	1015.1	63.10	24866.81	22176.47
743.59	636.85	1030.3	63.44	25162.44	22507.46
750.32	650.42	1045.4	63.78	25458.94	22838.46
756.98	664.03	1060.6	64.10	25756.28	23169.45
763.56	677.68	1075.7	64.42	26054.43	23500.44
770.07	691.37	1090.9	64.73	26353.36	23831.43
776.50	705.08	1106.0	65.03	26653.03	24162.42
782.86	718.84	1121.2	65.33	26953.48	24493.42
789.15	732.62	1136.4	65.62	27254.61	24824.41
795.37	746.44	1151.5	65.90	27556.43	25155.40
801.52	760.28	1166.7	66.18	27858.91	25486.39
807.60	774.16	1181.8	66.45	28162.03	25817.38
813.62	788.06	1197.0	66.72	28465.77	26148.38
819.58	801.99	1212.1	66.98	28770.11	26479.37
825.47	815.95	1227.3	67.24	29075.04	26810.36
831.30	829.94	1242.4	67.49	29380.53	27141.35
837.08	843.95	1257.6	67.73	29686.57	27472.35
842.79	857.98	1272.7	67.97	29993.13	27803.34
848.44	872.04	1287.9	68.21	30300.21	28134.33
854.04	886.11	1303.0	68.44	30607.79	28465.32
859.58	900.22	1318.2	68.66	30915.86	28796.31
865.07	914.34	1333.3	68.88	31224.39	29127.31
870.50	928.48	1348.5	69.10	31533.38	29458.30
875.88	942.65	1363.6	69.31	31842.81	29789.29
881.20	956.83	1378.8	69.52	32152.67	30120.28
886.48	971.04	1393.9	69.72	32462.94	30451.27
891.71	985.26	1409.1	69.92	32773.62	30782.27
896.88	999.50	1424.2	70.12	33084.70	31113.26
902.01	1013.75	1439.4	70.31	33396.16	31444.25
907.09	1028.03	1454.5	70.50	33707.99	31775.24
912.12	1042.32	1469.7	70.69	34020.18	32106.23
917.11	1056.63	1484.8	70.87	34332.73	32437.23
922.05	1070.95	1500.0	71.05	34645.62	32768.22

S U P E R C A T

NO OF CATS= 1 HOLDING POWER= 12000.0

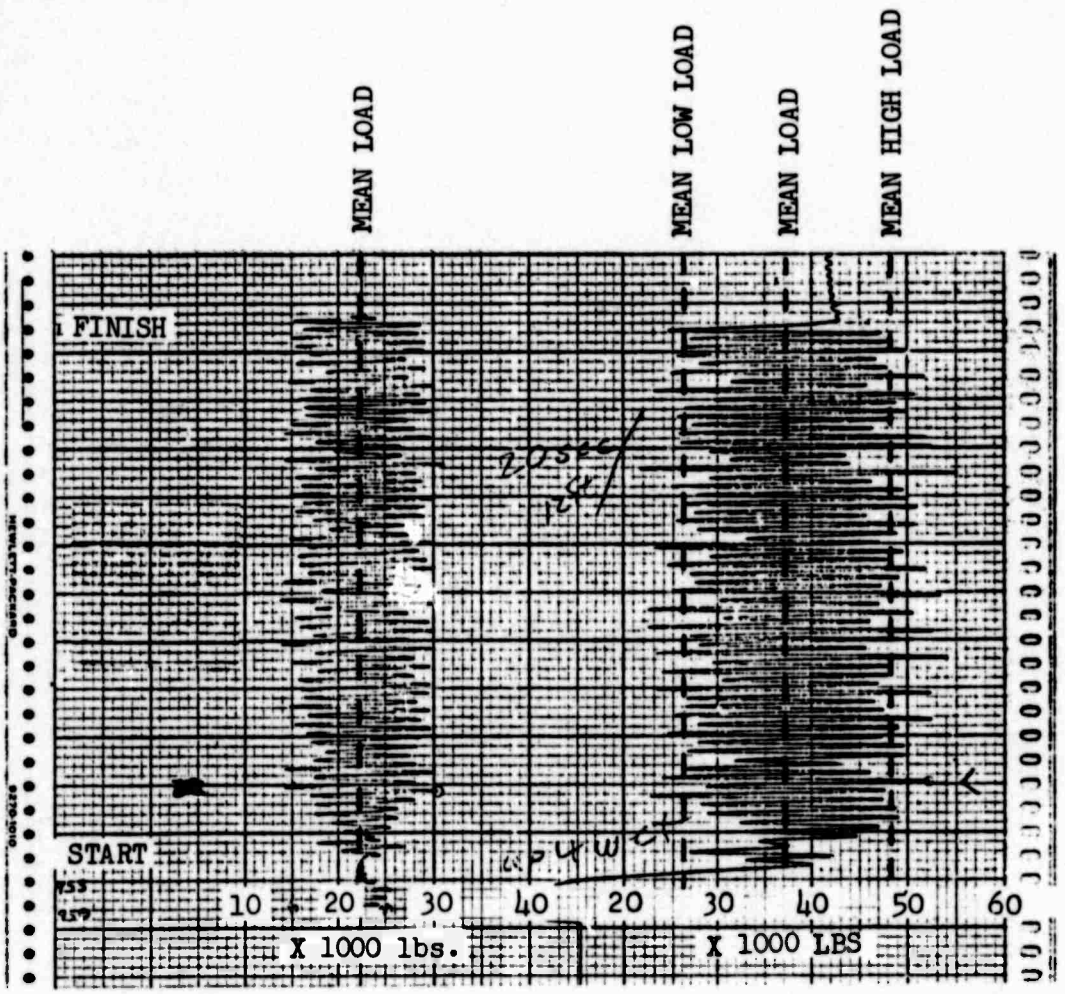
MTFT 21.8457 LENGTH OF LINE 1500.0 POINTS100 VERTICAL FORCE 0.0

X	Y	S	SLOPE	TENSION	VFORCE
0.00	0.00	0.0	0.00	12000.00	0.00
15.15	.21	15.2	1.58	12004.55	330.99
30.29	.84	30.3	3.16	12018.25	661.98
45.40	1.88	45.5	4.73	12041.01	992.94
60.48	3.35	60.6	6.30	12072.82	1323.97
75.52	5.20	75.8	7.85	12113.58	1654.96
90.50	7.47	90.9	9.40	12163.22	1985.95
105.41	10.15	106.1	10.93	12221.63	2316.94
120.25	13.21	121.2	12.44	12288.68	2647.94
135.04	16.67	136.4	13.94	12364.22	2978.93
149.66	20.51	151.5	15.42	12448.12	3309.92
164.21	24.73	166.7	16.88	12540.19	3640.91
178.65	29.31	181.8	18.31	12640.25	3971.91
192.97	34.25	197.0	19.73	12748.13	4302.91
207.17	39.53	212.1	21.11	12863.63	4633.89
221.24	45.16	227.3	22.48	12986.53	4964.88
235.17	51.11	242.4	23.81	13116.64	5295.87
248.96	57.39	257.6	25.12	13253.74	5626.87
262.61	63.98	272.7	26.40	13397.61	5957.84
276.10	70.86	287.9	27.66	13548.05	6288.85
289.45	78.04	303.0	28.88	13704.83	6619.84
302.63	85.50	318.2	30.08	13867.74	6950.83
315.67	93.22	333.3	31.25	14036.56	7281.83
328.54	101.21	348.5	32.39	14211.03	7612.82
341.25	109.45	363.6	33.50	14391.11	7943.81
353.81	117.94	378.8	34.59	14576.43	8274.80
366.20	126.65	393.9	35.65	14766.84	8605.79
378.43	135.59	409.1	36.68	14962.16	8936.79
390.50	144.75	424.2	37.68	15162.19	9267.78
402.42	154.11	439.4	38.66	15366.73	9598.77
414.17	163.68	454.5	39.61	15575.63	9929.75
425.76	173.43	469.7	40.53	15788.73	10260.76
437.20	183.37	484.8	41.43	16005.78	10591.75
448.48	193.48	500.0	42.31	16226.71	10922.74
459.61	203.76	515.1	43.16	16451.34	11253.73
470.59	214.21	530.3	43.99	16679.54	11584.72
481.41	224.81	545.4	44.80	16911.07	11915.72
492.09	235.56	560.6	45.58	17145.90	12246.71
502.62	246.45	575.8	46.35	17383.86	12577.70
513.01	257.48	590.9	47.09	17624.82	12908.69
523.25	268.64	606.1	47.81	17868.67	13239.68
533.36	279.93	621.2	48.51	18115.29	13570.68
543.33	291.34	636.4	49.20	18364.54	13901.67
553.16	302.87	651.5	49.86	18616.35	14232.65
562.86	314.51	666.7	50.51	18870.61	14563.65
572.43	326.25	681.8	51.14	19127.22	14894.65
581.87	338.10	697.0	51.76	19386.08	15225.64
591.19	350.05	712.1	52.35	19647.10	15556.63
600.38	362.09	727.3	52.94	19910.21	15887.62
609.45	374.23	742.4	53.50	20175.32	16218.61
618.41	386.45	757.6	54.05	20442.34	16549.61
627.24	398.76	772.7	54.59	20711.22	16880.60
635.96	411.15	787.9	55.12	20981.87	17211.59
644.57	423.62	803.0	55.63	21254.23	17542.58
653.07	436.16	818.2	56.12	21528.23	17873.57

661.47	448.78	833.3	56.61	21803.81	18204.57
669.75	461.46	848.5	57.08	22080.92	18535.55
677.93	474.21	863.6	57.54	22359.49	18866.55
686.02	487.03	878.8	57.99	22639.47	19197.54
694.00	499.91	893.9	58.43	22920.81	19528.53
701.88	512.85	909.1	58.86	23203.47	19859.53
709.67	525.84	924.2	59.28	23487.38	20190.52
717.36	538.89	939.4	59.68	23772.51	20521.51
724.97	552.00	954.5	60.08	24058.82	20852.51
732.48	565.16	969.7	60.47	24346.26	21183.51
739.90	578.37	984.8	60.85	24634.80	21514.49
747.24	591.62	1000.0	61.22	24924.38	21845.49
754.49	604.92	1015.1	61.58	25214.99	22176.47
761.66	618.27	1030.3	61.94	25506.59	22507.46
768.75	631.66	1045.4	62.28	25799.13	22838.46
775.76	645.10	1060.6	62.62	26092.59	23169.45
782.69	658.57	1075.7	62.95	26386.94	23500.44
789.54	672.08	1090.9	63.27	26682.15	23831.43
796.32	685.64	1106.0	63.59	26978.19	24162.42
803.02	699.22	1121.2	63.90	27275.03	24493.42
809.65	712.85	1136.4	64.20	27572.65	24824.41
816.21	726.51	1151.5	64.50	27871.03	25155.41
822.70	740.20	1166.7	64.79	28170.13	25486.39
829.12	753.92	1181.8	65.07	28469.94	25817.39
835.47	767.68	1197.0	65.35	28770.43	26148.38
841.76	781.46	1212.1	65.62	29071.58	26479.37
847.98	795.28	1227.3	65.89	29373.38	26810.36
854.14	809.12	1242.4	66.15	29675.80	27141.35
860.23	822.99	1257.6	66.40	29978.82	27472.35
866.27	836.89	1272.7	66.65	30282.43	27803.34
872.24	850.81	1287.9	66.90	30586.61	28134.33
878.15	864.76	1303.0	67.14	30891.33	28465.32
884.01	878.74	1318.2	67.38	31196.60	28796.31
889.81	892.73	1333.3	67.61	31502.38	29127.31
895.55	906.75	1348.5	67.84	31808.67	29458.31
901.24	920.80	1363.6	68.06	32115.44	29789.29
906.88	934.86	1378.8	68.28	32422.73	30120.29
912.46	948.95	1393.9	68.49	32730.42	30451.27
917.99	963.05	1409.1	68.70	33038.53	30782.27
923.47	977.18	1424.2	68.91	33347.19	31113.26
928.89	991.33	1439.4	69.11	33656.22	31444.25
934.27	1005.49	1454.5	69.31	33965.66	31775.24
939.60	1019.67	1469.7	69.51	34275.51	32106.23
944.88	1033.88	1484.8	69.70	34585.74	32437.23
950.11	1048.09	1500.0	69.89	34896.36	32768.22

APPENDIX B

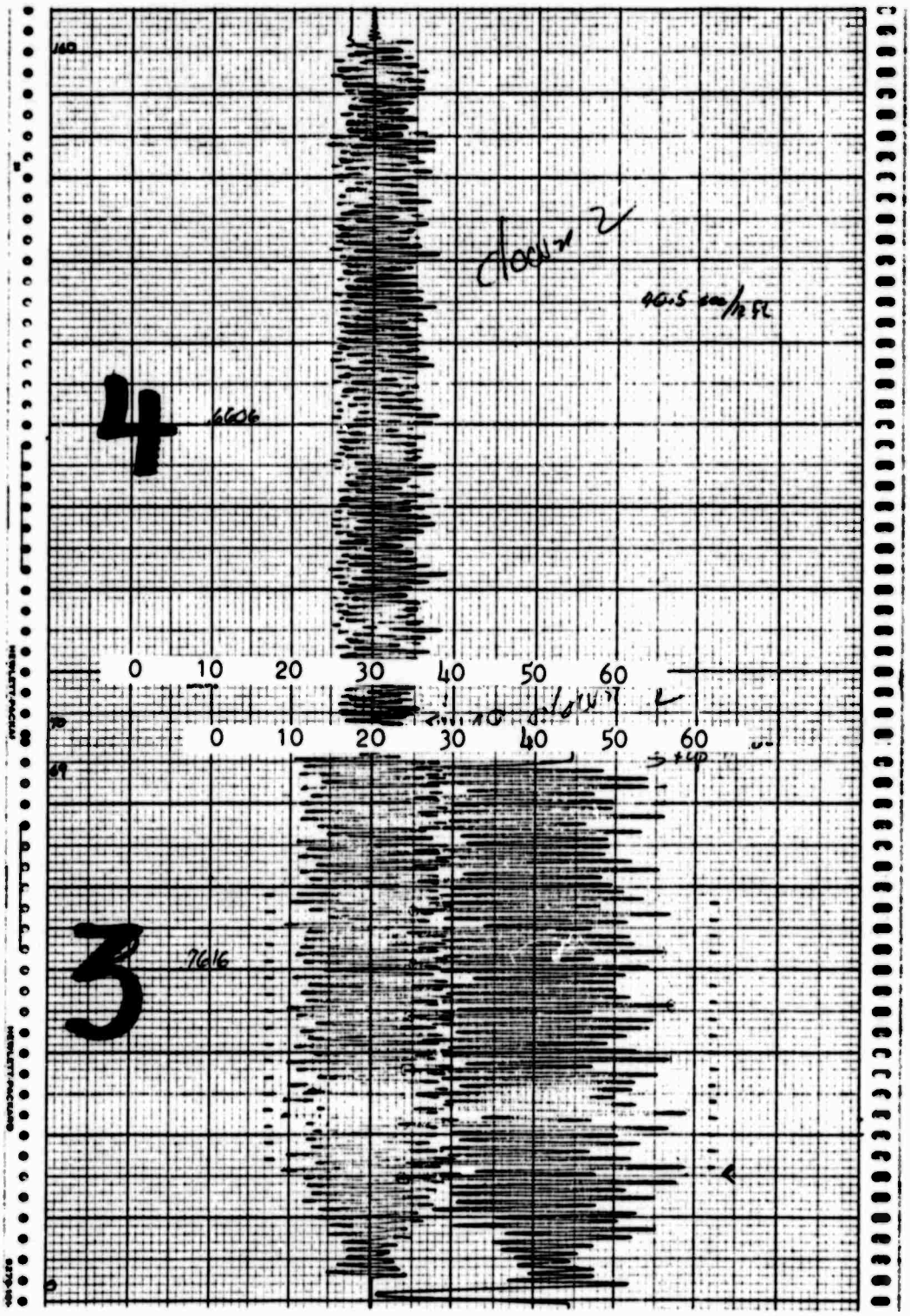
DYNAMOMETER / STRIPCHART READOUTS OF THE BOLSTER EFFICENCY TESTS



TEST WEIGHT
LOAD CELL READOUT

TOPSIDE WINDLASS
LOAD CELL READOUT

FORMAT STRIP CHART READOUT FOR THE
BOLSTER EFFICIENT TESTS


4
3
0 10 20 30 40 50 60
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SHIPBOARD NAVAL ENGINEERING SERVICES SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject BOLSTER EFFICIENCY TEST # 3 Chkd. JCS date

Sheet No. of

UP ONE, DRY, FIRST RUN

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
52.8	29.2	38.5	22.
50.	25.5	39.7	19.9
52.2	31.1	38.5	23.6
52.6	28.7	39.3	21.
55.2	24.	40.2	19.8
47.2	31.7	37.9	23.1
56.8	25.4	40.	20.6
53.7	29.6	38.4	22.4
49.1	26.3	38.8	21.4
51.5	30.5	38.	23.3
54.2	27.5	40.1	20.9
54.7	24.5	40.3	19.8
47.	30.7	38.4	22.1
57.3	24.9	39.9	21.5
52.	29.4	38.8	22.5
50.2	24.9	39.5	20.5
50.	32.6	37.7	24.5
TOTAL 884.5	476.5	664.0	386.9
AVE. 52.1471	28.0294	39.0588	21.7588

MEAN: 40.0883 30.4088

WILDCAT DRAG .0794 1.980

CORRECTED MEAN 39.8903

BOLSTER EFFICIENCY 0.76231

CALCULATION WORK SHEET

NAVAL SEA SYSTEMS ENGINEERING STATION SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject BOLSTER EFFICIENCY TEST # 4 Chkd. JCS date
Sheet No. of

DOWN TWO, DRY 17.778 FPM

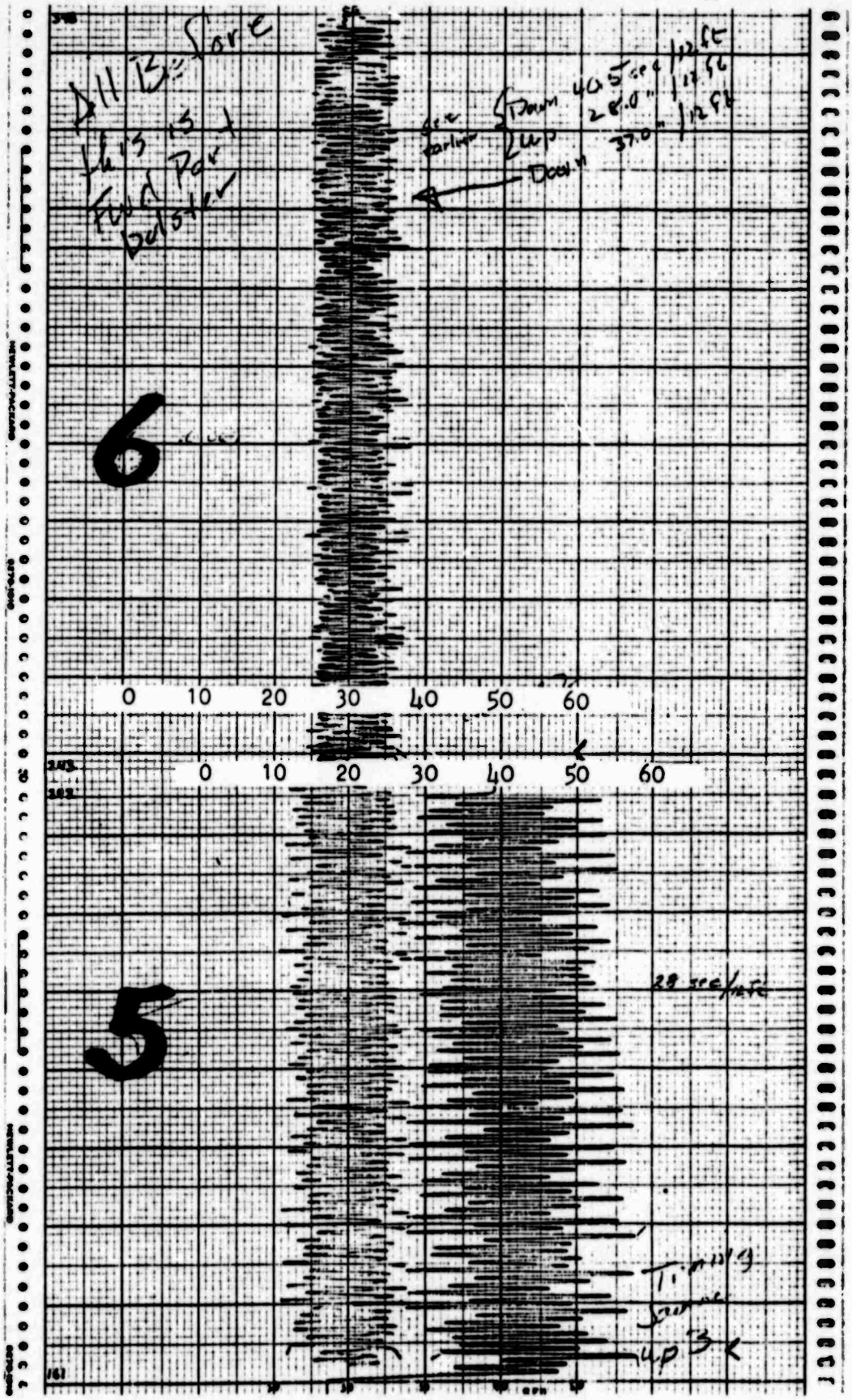
IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
23.5	16.7	35.	26.
23.9	16.3	35.4	26.
25.6	17.8	34.7	26.4
23.5	17.2	34.5	26.7
23.3	19.4	32.5	26.9
25.	17.8	33.9	25.4
27.4	18.2	36.3	26.2
24.0	16.3	34.4	25.7
25.6	17.5	35.4	26.8
23.7	16.1	33.9	25.5
26.8	17.9	35.7	26.7
23.1	17.3	32.8	25.9
26.2	17.5	35.	25.0
28.4	18.7	36.1	26.0
25.6	16.7	35.1	25.5
24.2	16.4	35.8	25.4
25.3	17.0	35.3	26.4
TOTAL 425.0	293.8	591.8	442.5
AVE. 25.0	17.2823	34.8118	26.0294

MEAN 21.1412 30.4206

WILDCAT DRAG 1.3445

CORRECTED MEAN 22.4858

BOLSTER EFFICIENCY .7391


6
5
0 10 20 30 40 50 60
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SHIPBOARD SYSTEMS ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JANIE date

Subject BOLSTER EFFICIENCY TEST # 5 Chkd. date

Sheet No. of

UP THREE, DRY 25.714 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
57.8	32.1	35.9	22.3
50.4	34.5	34.7	24.3
53.9	33.5	36.1	22.5
51.5	30.1	36.5	22.7
47.8	32.5	35.5	23.4
50.8	36.6	35.8	25.1
56.5	27.5	38.0	21.0
49.4	35.8	36.0	24.3
54.2	27.9	37.7	21.8
46.3	33.0	35.4	24.0
51.7	36.5	35.7	24.7
57.5	27.6	37.5	21.2
49.0	35.8	35.3	23.9
50.8	30.8	35.4	24.2
48.7	31.1	36.1	23.1
49.3	37.6	35.3	25.6
57.6	27.7	37.5	21.4
TOTAL 883.4	550.8	614.4	395.5
AVE. 51.9647	32.4000	36.1412	23.2647

MEAN 42.1823 29.7029

WILDCAT DRAG .0494 2.0838

CORRECTED MEAN 40.0984

BOLSTER EFFICIENCY 0.74075

CALCULATION WORK SHEET

SURVEY OF [illegible] SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject: Chkd. date

TOWED EFFICIENCY TEST # 6 Sheet No. of

DOWN TWO, DRY 19.459 FPM

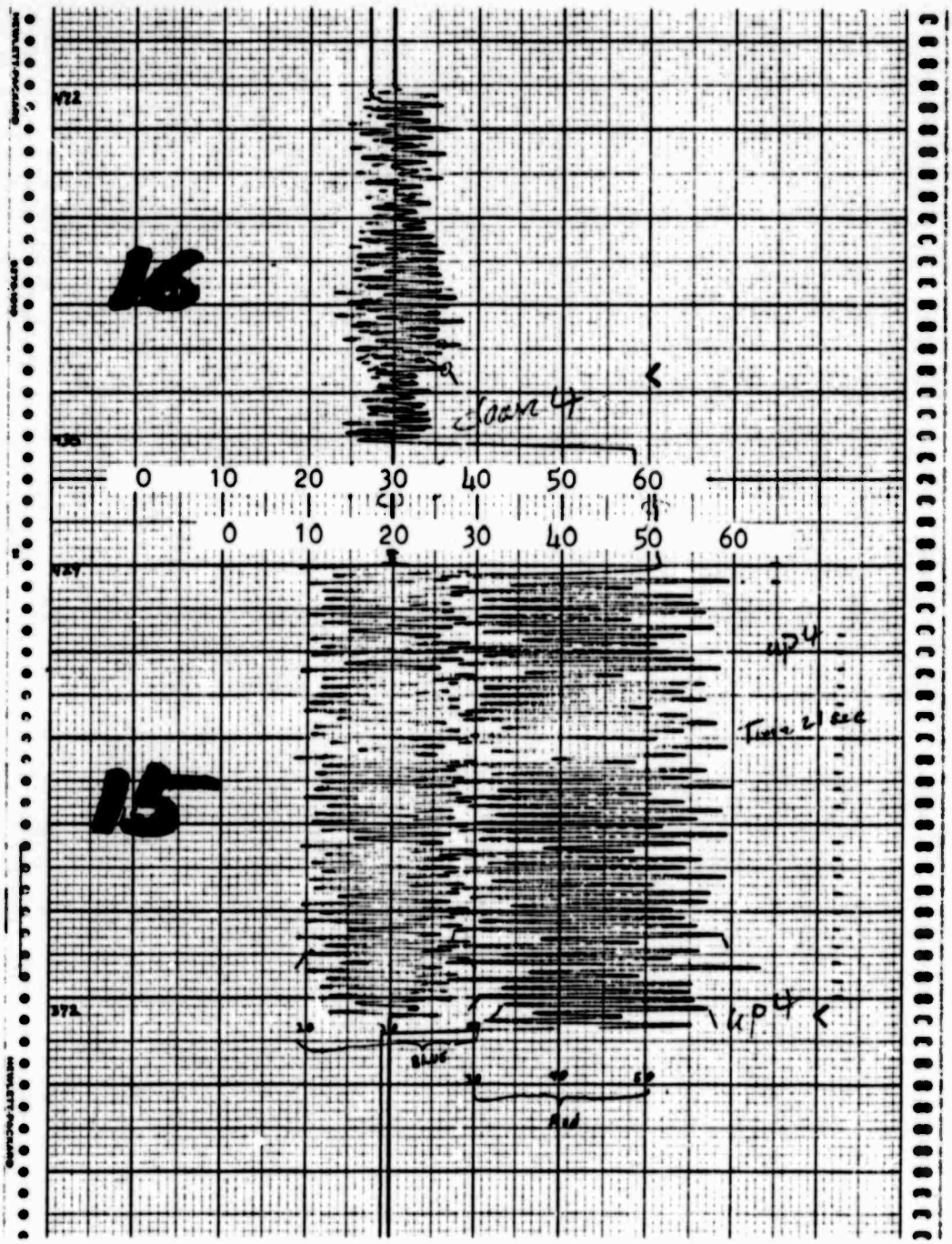
IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
26.1	16.7	36.2	26.5
23.2	15.7	34.6	25.7
25.1	17.	34.3	24.3
27.	17.8	35.8	25.4
25.8	16.4	35.3	25.8
24.2	16.2	35.8	26.
24.1	15.8	36.5	26.5
25.6	16.5	35.3	26.0
23.4	15.9	34.5	25.9
24.9	16.8	35.3	25.0
26.3	18.5	35.1	25.6
25.3	16.1	35.3	25.3
23.7	15.5	36.5	25.8
24.	15.8	36.1	26.2
24.1	16.3	33.9	25.6
24.	16.4	36.6	26.3
23.7	16.3	35.4	24.5
TOTAL 420.5	279.7	602.5	436.4
AVE. 24.7353	16.4529	35.4412	25.6706

MEAN: 20.5941 30.5559

WILDCAT DRAG 1.3097

CORRECTED MEAN 21.9038

BOLSTER EFFICIENCY .7168


0 10 20 30 40 50 60
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SALVAGE [illegible] ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. [illegible] date

Subject [illegible] TESTED EFFICIENCY TEST # 15 Chkd. JAMIE date

Sheet No. of

UP FOUR, DRY 34.286 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
57.	30.5	39.4	19.7
55.5	33.3	37.4	22.3
55.1	26.8	39.6	18.9
55.3	36.5	36.0	25.
49.2	26.6	38.6	19.9
63.5	33.2	37.6	21.5
52.9	25.5	39.4	19.3
56.0	37.9	37.1	23.7
49.1	27.6	38.2	20.8
59.	30.4	38.7	20.2
55.9	27.0	37.	21.8
54.5	34.3	38.9	20.5
53.0	29.4	38.3	22.3
57.0	27.2	40.2	19.3
57.4	32.0	36.2	25.5
50.8	26.4	37.	21.7
59.2	31.5	39.1	20.5
TOTAL 940.4	516.1	648.7	362.9
AVE. 55.3176	30.3588	38.1588	21.3470

MEAN 42.9382 29.7529

WILDCAT DRAG .0094 2.1162

CORRECTED MEAN 40.7220

BOLSTER EFFICIENCY .7306

CALCULATION WORK SHEET

SHIPBOARD ... ENGINEERING SYSTEMS SECTION 6162B

U.S.S. ORTOLAN ASR-22 Calc. JAMES date

Subject Chkd. JAMIE date

BOLSTER EFFICIENCY TEST # 16 Sheet No. of

DOWN FOUR, DRY

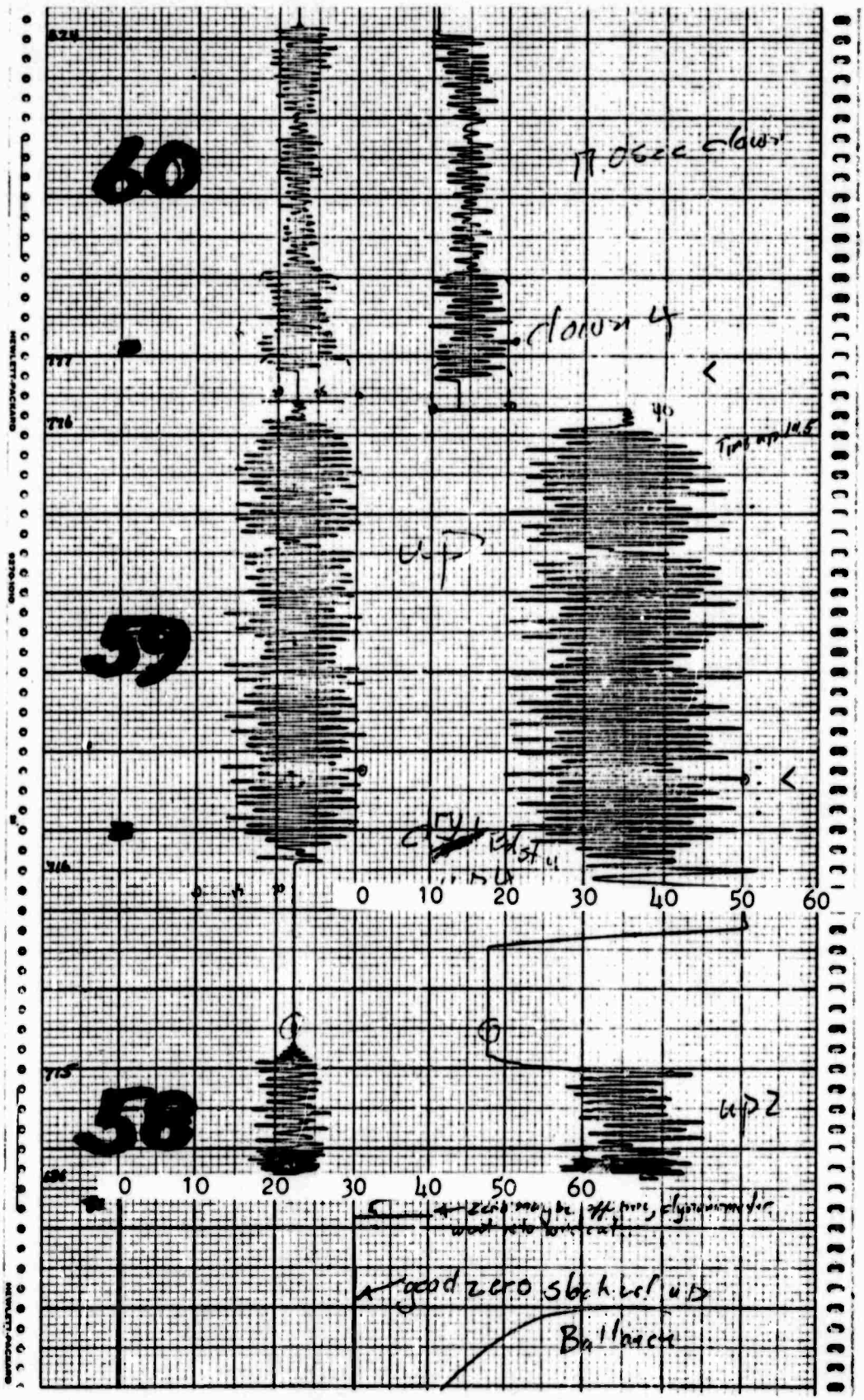
IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
26.2	18.5	33.7	27.2
23.7	17.6	33.1	25.8
25.7	15.5	35.8	24.1
27.9	17.7	35.	23.
24.9	17.1	34.1	25.4
25.3	15.0	35.5	26.2
28.3	17.8	35.5	22.9
25.3	16.9	35.	25.8
26.5	14.6	37.3	25.2
27.4	16.6	37.	25.3
25.6	16.7	34.7	25.6
25.9	16.0	35.4	25.7
25.6	18.7	34.6	24.7
25.3	16.7	35.1	25.8
25.0	15.6	35.	25.9
25.0	15.7	34.6	26.5
25.9	16.6	34.9	27.4
TOTAL 439.5	288.5	596.3	432.5
AVE. 25.8529	16.9706	35.0764	25.4411

MEAN 21.4117 30.2587

WILDCAT DRAG 1.3617

CORRECTED MEAN 22.7422

BOLSTER EFFICIENCY .7515


60
59
58
0 10 20 30 40 50 60
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SHIPBOARD COMBAT ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JRM:2 date

Subject: TOWED BODY TEST #59 Chkd. date

Sheet No. of

UP FOUR, DRY 36.923 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
50.5	19.7	31.2	13.2
42.2	25.5	27.4	18.0
41.0	27.2	28.2	17.5
47.9	21.5	29.3	16.2
45.0	26.0	29.0	16.5
45.7	20.8	31.4	14.3
45.4	26.3	28.9	17.6
49.8	20.5	30.5	13.5
43.0	24.8	29.0	17.3
45.5	23.2	30.0	15.0
48.2	21.5	30.5	15.8
44.0	24.3	28.4	16.2
45.2	26.0	31.2	14.7
44.1	26.5	28.8	17.8
49.8	20.5	30.4	13.4
42.7	25.6	27.5	17.1
41.0	27.7	27.4	18.4
TOTAL 771.0	403.3	496.9	273.3
AVE. 45.3529	23.7235	29.2294	16.0764

MEAN 34.5382 22.6529

WILDCAT DRAG .0170 1.7062

CORRECTED MEAN 32.8320

BOLSTER EFFICIENCY .6899

CALCULATION WORK SHEET

[illegible] SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. [illegible] date

Subject Chkd. JAMIE date

BOLSTER EFFICIENCY TEST # 60 Sheet No. of

DOWN FOUR, DRY 42.353 FPM

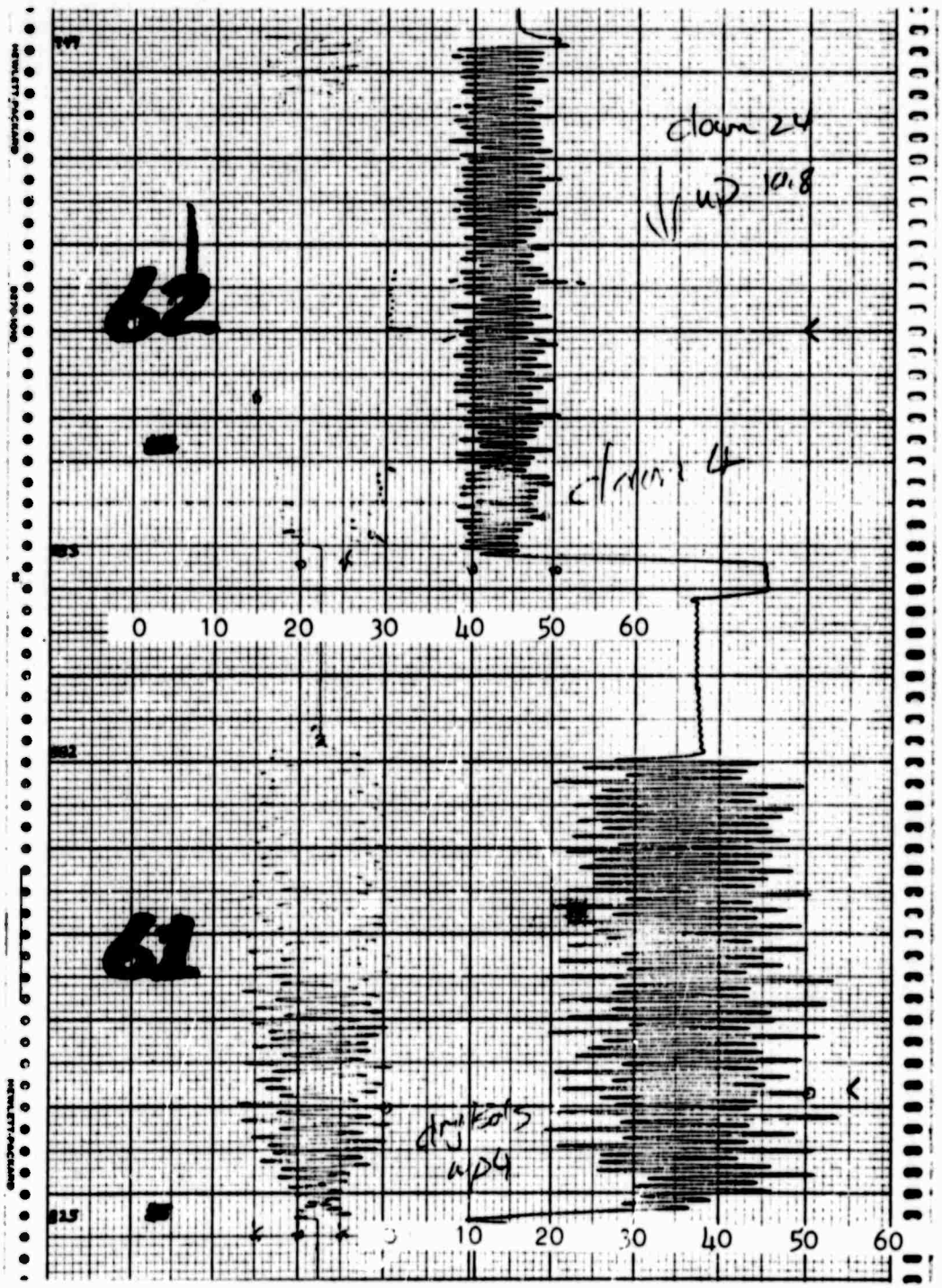
IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
19.6	10.5	28.5	18.5
17.5	10.5	26.8	17.8
19.5	10.2	27.4	17.3
19.7	10.8	27.2	18.
21.2	12.3	26.2	19.4
18.	12.7	25.4	19.8
18.4	9.5	26.3	17.4
20.5	13.	25.8	19.8
16.9	11.6	25.6	19.1
19.6	11.9	26.7	19.1
17.8	12.5	25.2	19.
19.	10.1	27.2	18.3
18.6	11.	26.5	18.4
18.5	10.	26.8	18.
19.4	12.8		
Total 284.2	169.4	371.6	259.9
Ave. 18.9	11.29	26.5428	18.5642

MEAN 15.1183 22.5535

WILDCAT DRAG .9615
.0636

CORRECTED MEAN 16.0798

BOLSTER EFFICIENCY .7129


62
61
0 10 20 30 40 50 60
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SHIPYARD [illegible] ENGINEERING SURVEYS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMES date

Subject Chkd. JAMIE date

BOLSTER EFFICIENCY TEST # 61 Sheet No. of

UP FOUR, DRY 36.364 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
[illegible]	21.4	30.4	13.0
[illegible]	[illegible]	27.0	17.4
[illegible]	[illegible]	[illegible]	16.[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	28.[illegible]	[illegible]
[illegible]	[illegible]	31.6	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
51.6	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	16.9
[illegible]	22.0	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

TOTAL	798.0	415.4	491.	273.3
AVE.	46.9412	24.4235	28.8823	16.0765

MEAN 35.6824 22.4773

WILDCAT DRAG .0494 1.7627

CORRECTED MEAN 33.9196

BOLSTER EFFICIENCY 0.6627

CALCULATION WORK SHEET

SHIPBOARD SOLID MECHANICS SYSTEM'S SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMES date

Subject "DYNAMIC EFFICIENCY TEST" 62 Chkd. JAMIE date

Sheet No. of

DOWN FOUR DRY 30.0 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
16.7	8.2	27.7	15.9
20.1	8.8	29.2	17.4
17.3	7.7	28.	16.5
19.7	10.	27.	17.6
18.	7.3	29.2	16.7
18.1	10.8	28.2	18.7
17.	8.5	27.	17.5
17.5	8.	27.6	16.5
21.5	8.7	29.4	16.2

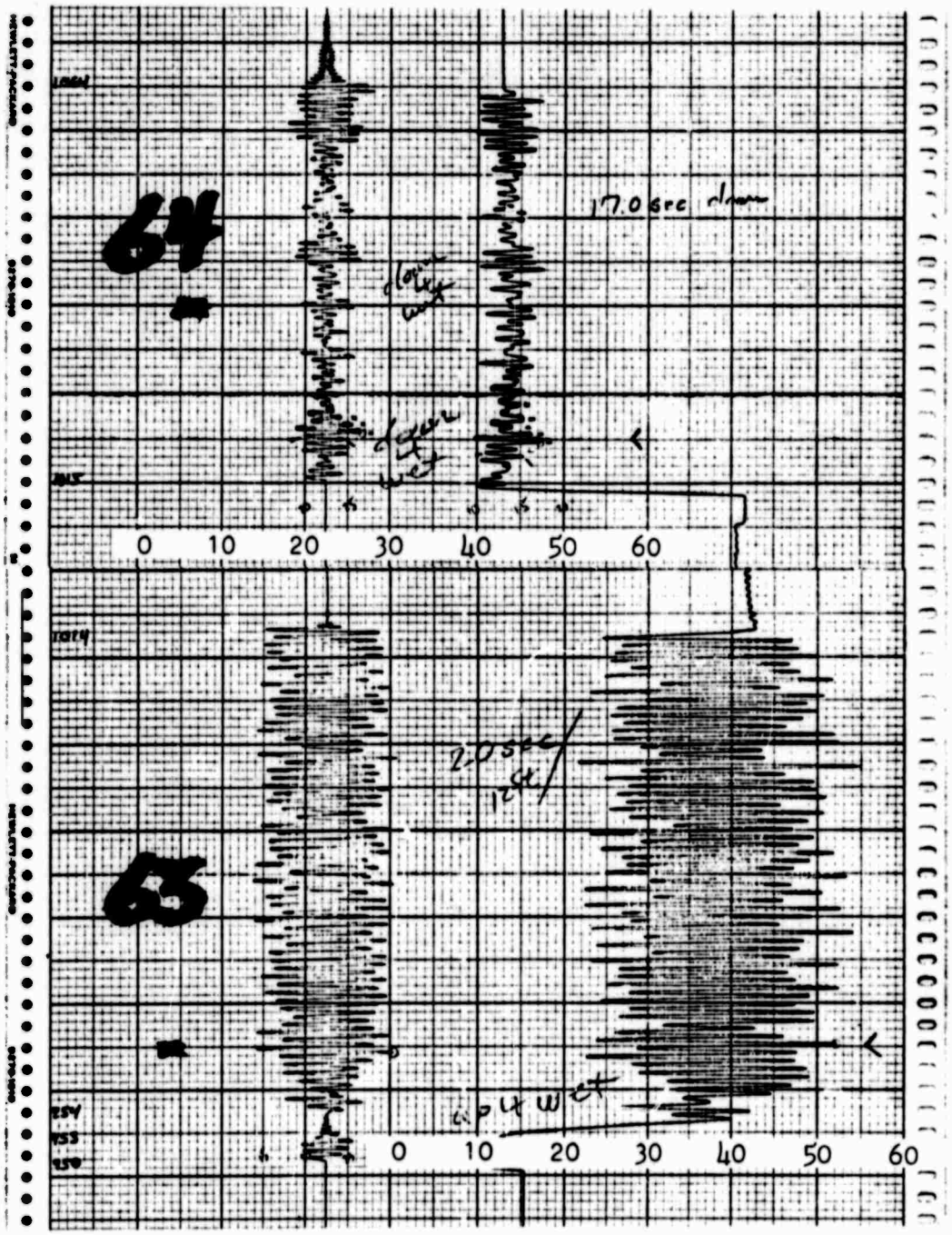
TOTAL	165.9	78.	253.3	153.0
AVE.	18.4333	8.6666	28.1444	17.000

MEAN 13.5499 22.5722

WILDCAT DRAG .86177

CORRECTED MEAN 14.4116

BOLSTER EFFICIENCY .6385


64
17.0 sec down
0 10 20 30 40 50 60
2.0 sec/
63
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SALVAGE ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject: TOWED EFFICIENCY TEST #63 Chkd. date

Sheet No. of

UP FOUR, WET 36.0 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
52.2	23.8	30.4	13.
46.1	24.0	28.0	13.
42.8	31.8	29.0	12.
49.6	24.	28.1	14.
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47.5	24.	28.2	
[illegible]	27.8	26.	15.
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[illegible]	[illegible]	[illegible]	16.3
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48.0	[illegible]	[illegible]	[illegible]
49.1	[illegible]	[illegible]	17.6
[illegible]	[illegible]	24.6	14.9
[illegible]	[illegible]	27.	17.5
[illegible]	[illegible]	[illegible]	14.0
TOTAL 828.7	450.6	491.4	273.8
AVE. 48.7471	26.5058	28.9058	16.1058

MEAN 37.6264 22.5058

WILDCAT DRAG .0094 1.9587

CORRECTED MEAN 35.7676

BOLSTER EFFICIENCY .62922

CALCULATION WORK SHEET

SUBJECT TO ENGINEERING SERVICES SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject TOWED EFFICIENCY TEST #64 Chkd. JCS date
Sheet No. of
DOWN FOUR, WET 42.353 FPM

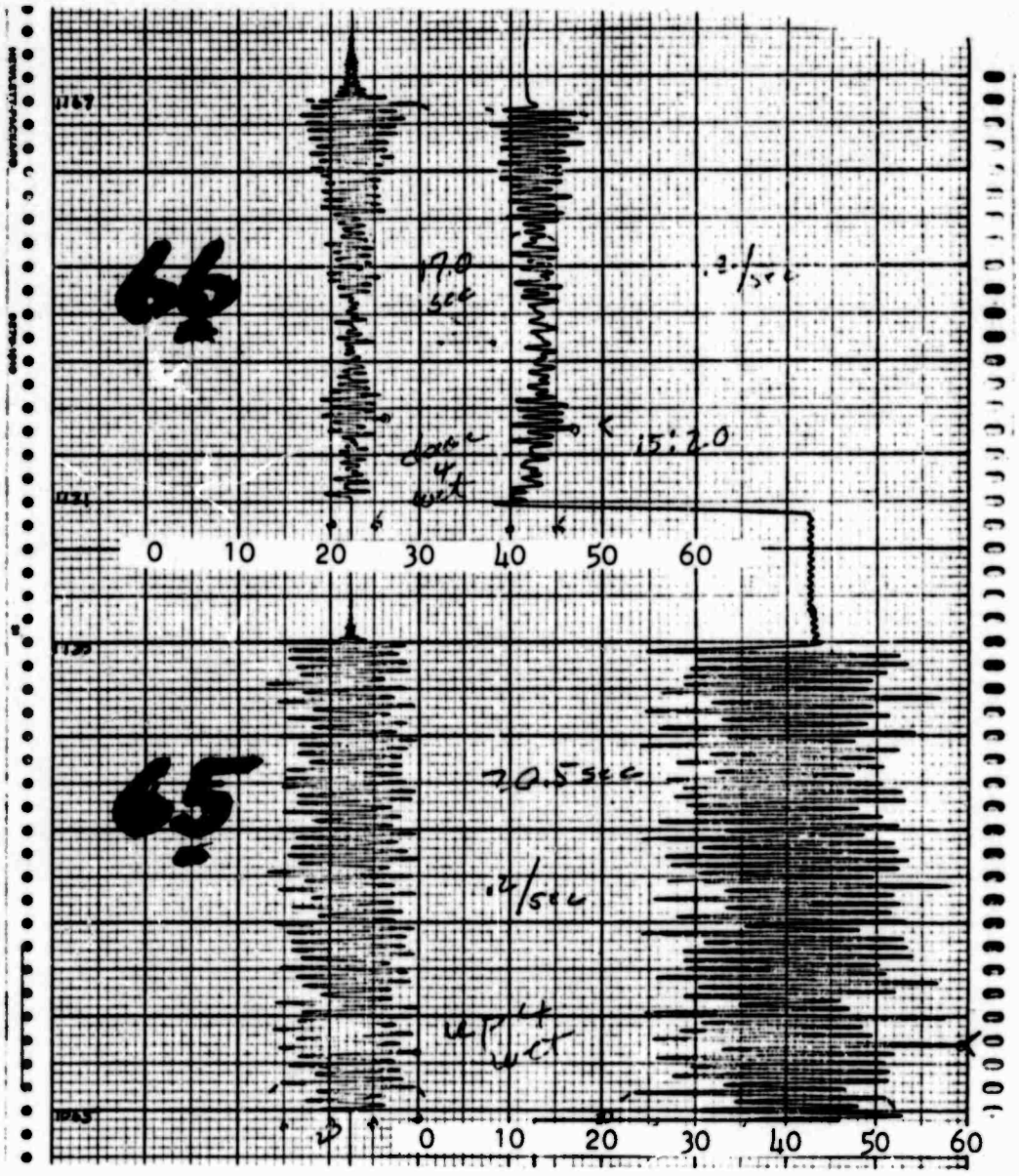
IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
17.3	09.6	26.7	20.0
16.3	12.5	25.6	19.9
14.1	11.6	24.3	19.5
15.3	12.7	23.3	20.6
13.7	13.3	23.2	20.3
14.8	12.8	23.0	21.4
14.3	14.2	23.9	21.8
13.4	11.8	23.1	21.0
14.3	14.3	24.6	21.3
14.7	13.0	23.4	21.6
15.0	13.2	23.1	20.8
14.0	10.7	23.5	22.0
13.0	13.1	23.3	21.4
14.0	13.7	24.5	20.7
13.2	12.0	22.6	19.5
15.2	12.2	23.0	22.0
16.7	13.5	21.0	21.8
TOTAL 258.7	213.0	385.8	355.9
AVE. 15.2176	12.5294	22.6941	20.9353

MEAN 13.8735 21.8146

WILDCAT DRAG .0656 .8023

CORRECTED MEAN 14.7558

EOLETZR EFFICIENCY 0.6764


66
9.0 sec
.2/sec
15:20
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65
-0.5 sec
.2/sec
0 10 20 30 40 50 60

CALCULATION WORK SHEET

[illegible] OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMES date
Subject Chkd. JAMIE date
FOLSTER EFFICIENCY TEST # 65 Sheet No. of

UP FOUR, WET 35.122 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
51.1	23.5	29.8	14.6
46.7	33.	28.4	18.4
51.5	27.5	27.9	15.5
51.6	29.5	27.4	16.4
51.	25.7	29.9	14.4
52.	32.9	28.	16.4
59.7	25.3	29.4	13.7
49.5	28.2	27.5	16.4
48.5	30.5	29.3	17.
57.5	24.5	30.	14.
47.	34.8	27.1	19.
46.	28.8	27.	17.
52.1	30.2	29.3	16.3
56.7	25.8	28.9	14.5
51.1	29.	26.9	16.8
50.3	28.8	29.7	15.8
54.	28.6	28.6	15.8
TOTAL 876.3	486.6	485.1	272.0
AVE. 51.5470	28.6235	28.5352	16.000

MEAN 40.0852 22.2676

W/LOCAT DRAG .0494 1.9802

CORRECTED MEAN 38.1049

FOLSTER EFFICIENCY .5843

B22.,

CALCULATION WORK SHEET

SALVAGE AND ENGINEERING SERVICES SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject: BOLSTER EFFICIENCY TEST # 66 Chkd. JAMIE date

Sheet No. of

DOWN FOUR, WET 42.353 R.P.M.

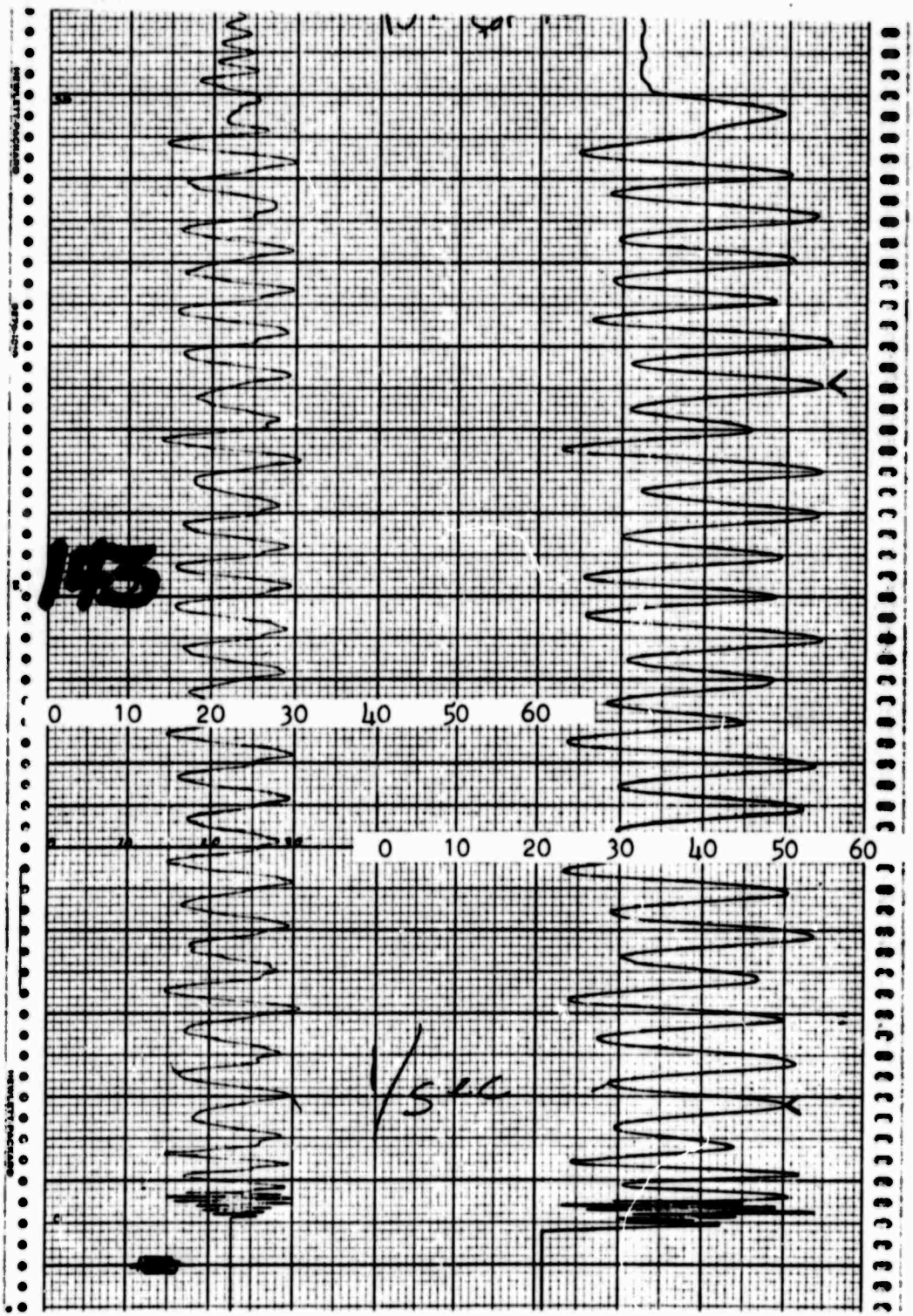
IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
17.2	8.7	30.	18.6
16.6	9.8	27.6	17.9
17.4	7.7	28.5	16.7
16.4	9.	27.4	17.3
18.	8.6	27.6	17.4
16.	8.9	26.7	17.5
16.5	9.8	26.4	18.4
15.5	8.5	27.2	17.7
15.7	10.2	26.	18.7
15.6	8.8	27.2	17.8
14.6	10.	25.7	19.
16.7	10.	25.4	19.4
14.9	9.9	25.8	19.1
15.9	10.7	25.8	19.3
15.2	9.5	26.1	18.9
13.8	11.3	23.3	20.2
13.9	11.4	24.	20.8
TOTAL 269.9	162.8	450.7	314.7
AVG. 15.8765	9.5765	26.5117	18.5117

MEAN 12.7265 22.5117

WILDCAT DRAG .0636 .8094

CORRECTED MEAN 13.5359

BOLSTER EFFICIENCY .60128


0 10 20 30 40 50 60
0 10 20 30 40 50 60
1/5 sec

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject [illegible] TEST # 143 Chkd. date

Sheet No. of

UP DRY 34.8 RPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
50.2	28.7	29.6	16.5
51.5	27.3	28.4	17.
49.8	23.9	30.8	14.7
46.7	30.2	28.1	17.5
53.6	23.9	29.5	16.5
50.4	23.3	30.	14.9
48.5	29.6	28.2	17.2
[illegible]	29.7	29.5	16.1
[illegible]	23.5	29.8	14.7
45.	28.3	29.1	17.3
[illegible]	30.8	28.7	16.6
[illegible]	25.8	29.1	15.7
[illegible]	25.5	29.5	15.7
[illegible]	30.	29.1	[illegible]
[illegible]	32.3	28.	[illegible]
[illegible]	22.9	30.6	14.
45.6	30.9	28.	18.
TOTAL 852.7	471.8	406.0	276.8
AVE. 50.1588	27.7529	29.1765	16.2823

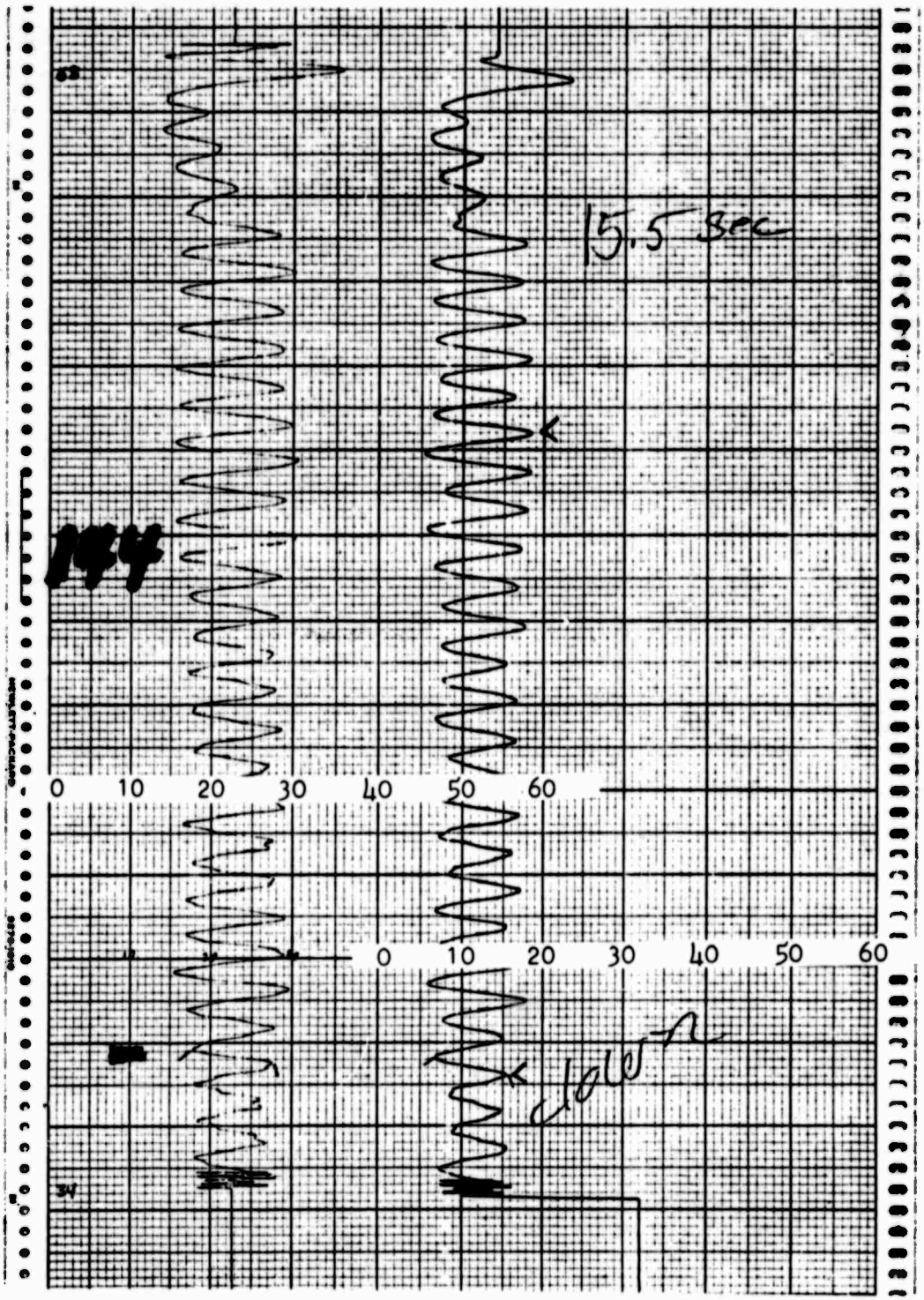
MEAN 38.9558 22.7294

WILDCAT DRAG .1298 5.0565

CORRECTED MEAN 33.8993

BOLSTER EFFICIENCY 0.6705

B25


15.5 sec
0 10 20 30 40 50 60
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject BOLSTER EFFICIENCY TEST #144 Chkd. date

Sheet No. of

DOWN DRY 34.8 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
15.4	6.8	27.5	17.8
15.1	7.7	27.8	17.1
17.9	6.9	29.7	15.5
18.2	7.	29.	16.9
15.4	6.8	29.1	16.9
17.3	8.4	27.7	17.7
16.1	7.2	27.5	16.5
17.	7.	29.	18.
16.5	8.3	27.	17.9
17.6	6.8	28.5	17.5
17.6	7.6	27.8	17.2
15.3	7.5	27.5	17.8
17.7	7.5	28.1	17.2
16.7	6.6	28.5	16.1
17.2	5.7	30.3	15.6
17.7	7.9	29.	16.
18.4	5.4	30.6	15.5
TOTAL 281.3	121.1	484.6	287.2
AVE. 16.9000	7.1235	28.5059	16.8941

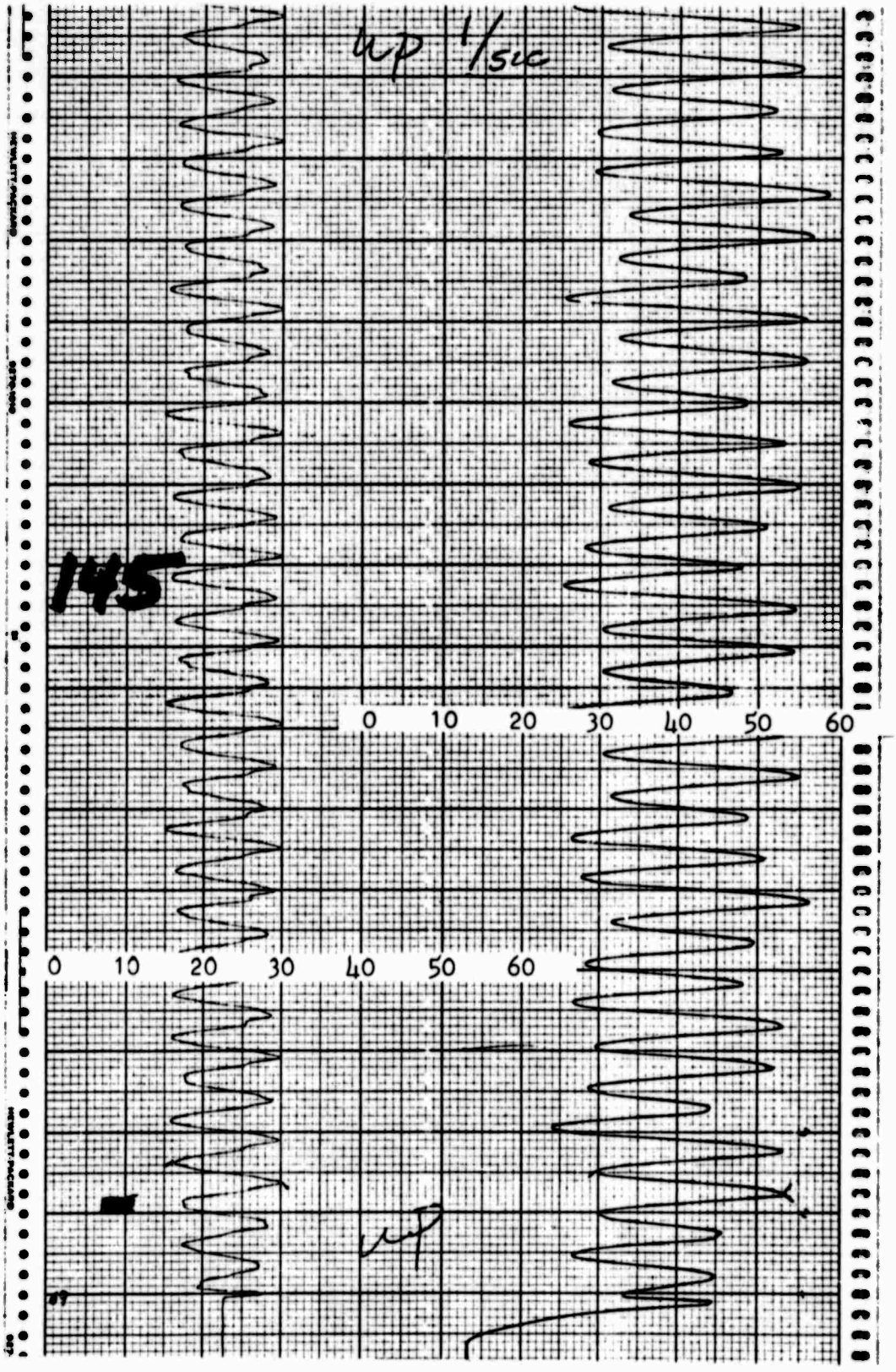
MEAN 12.0117 22.7000

WILDCAT DRAG 1.9903
.1657

CORRECTED MEAN 14.0020

BOLSTER EFFICIENCY .6168

B27


up 1/sec
145
0 10 20 30 40 50 60
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SHIPBOARD CODAR ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject BOLSTER EFFICIENCY TEST #145 Chkd. JS date

Sheet No. of

UP DRY 35.4 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
33.3	29.9	30.	16.3
53.1	23.9	29.9	15.8
44.2	28.6	28.8	17.6
51.9	29.5	29.9	15.9
53.	26.8	28.8	16.
48.2	28.3	29.5	16.1
49.7	31.6	28.2	16.5
56.2	27.8	29.	16.1
50.9	26.4	29.8	15.
48.7	31.4	28.	17.3
54.9	30.3	29.1	16.
53.	23.9	30.	15.1
46.7	30.3	28.2	16.8
54.3	30.4	29.6	16.3
54.5	25.3	29.1	15.8
48.	28.1	30.	16.9
51.	31.	29.2	15.
TOTAL 871.6	483.5	497.1	274.8
AVE. 51.2706	28.4412	29.2412	16.1647

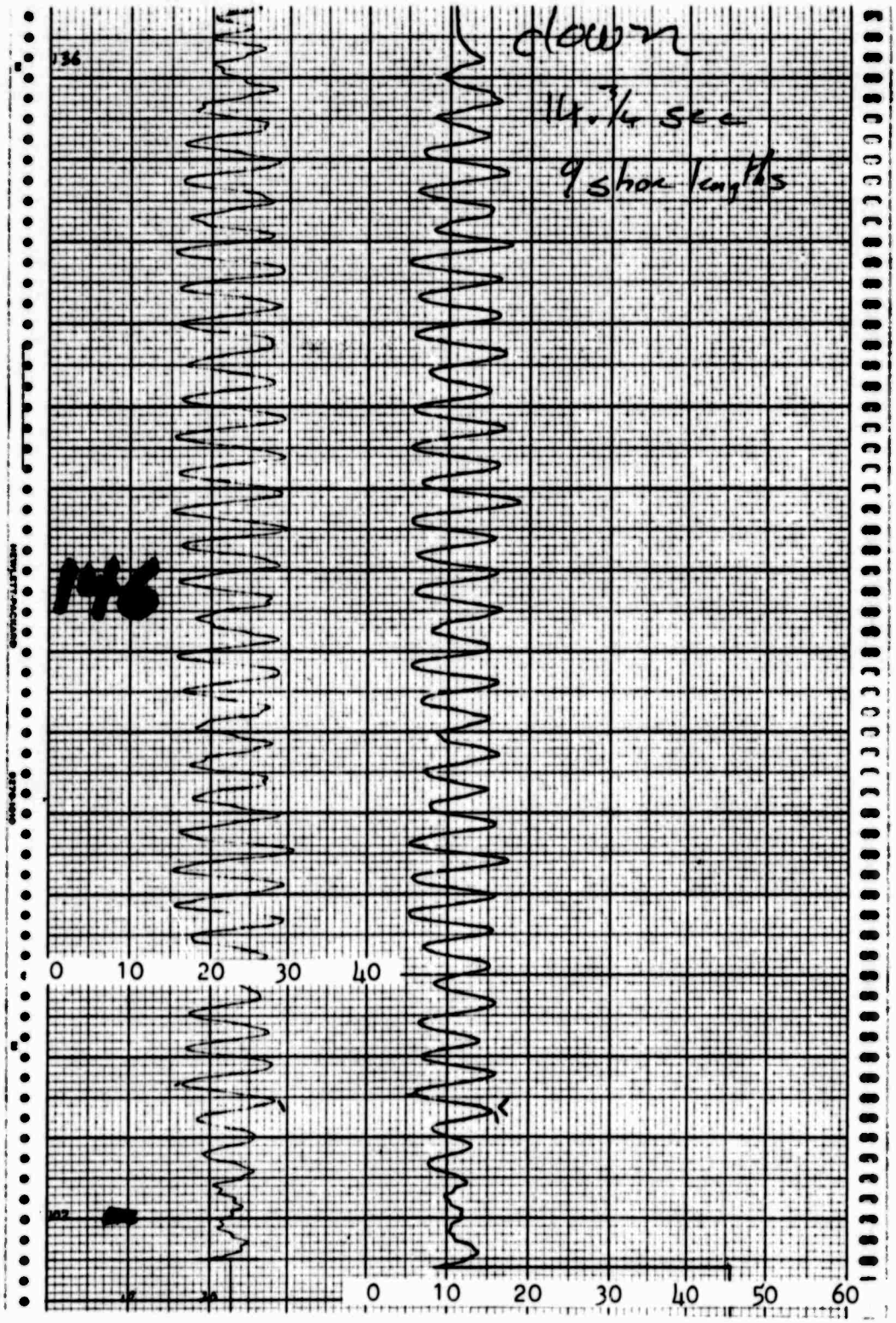
MEAN 39.8559 22.7029

WILDCAT DRAG .1298 5.1733

CORRECTED MEAN 34.6826

BOLSTER EFFICIENCY 0.6546

B29


down
11 3/4 sec
9 short lengths
0
10
20
30
40
50
60

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162B

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject BOLSTER EFFICIENCY TEST # 146 Chkd. JCS date

Sheet No. of

DOWN DRY 36.6 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
15.5	6.3	28.4	16.5
15.9	7.	28.	17.
14.	6.5	27.5	17.4
15.9	8.5	26.4	18.6
15.3	7.	27.3	17.6
15.6	5.4	29.4	15.4
15.8	5.8	29.5	15.3
17.5	5.3	30.3	16.1
15.9	2.8	28.9	17.8
14.8	7.2	27.2	17.4
16.2	8.5	27.9	18.1
15.1	6.8	27.5	16.5
16.1	5.5	28.7	16.8
15.	6.	28.8	18.
16.5	5.9	27.7	15.9
16.1	6.1	28.8	16.3
15.7	5.6	29.9	15.
TOTAL 266.9	113.2	482.6	285.7
AVE. 15.7000	6.6588	28.3882	16.8059

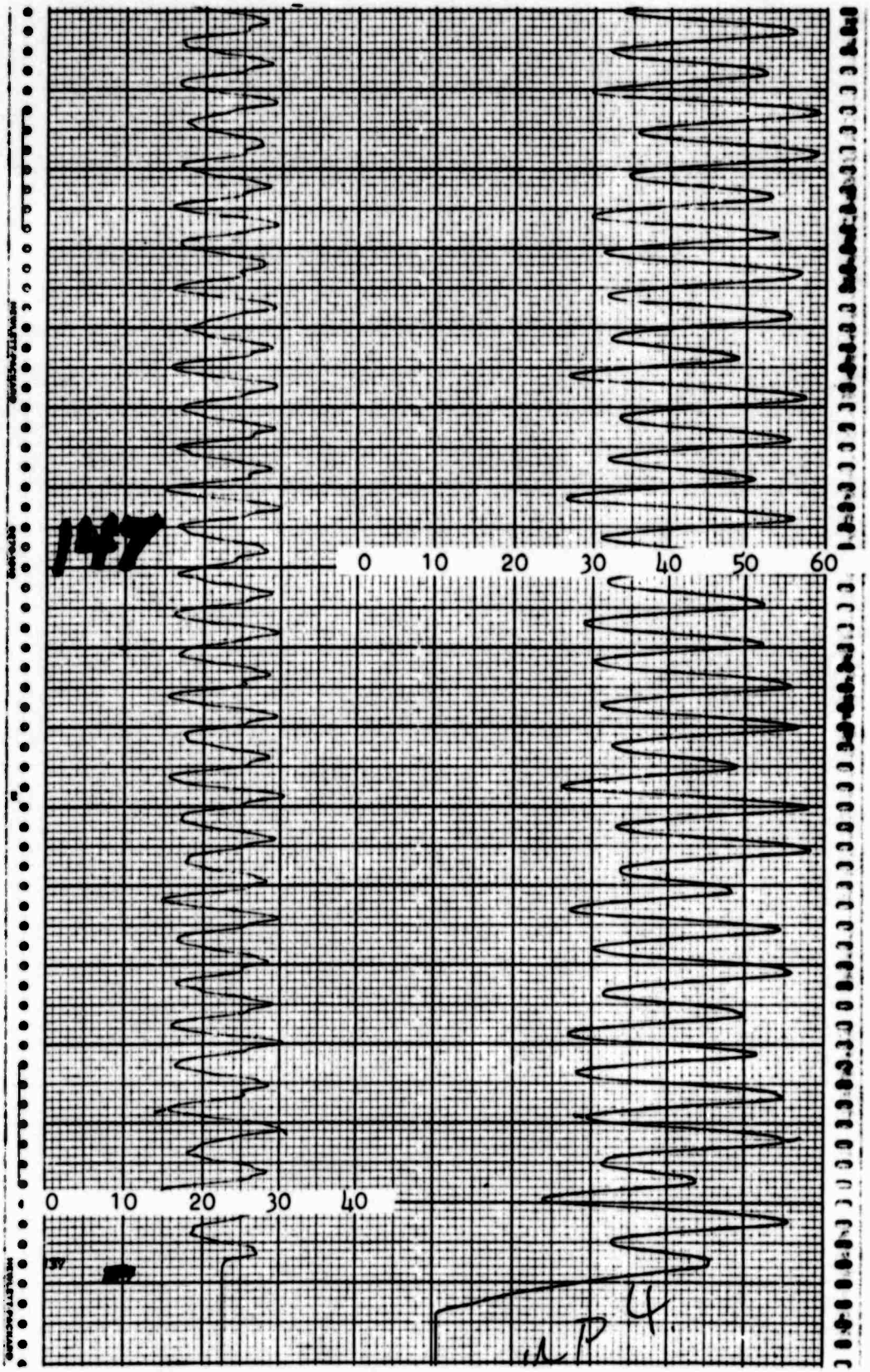
MEAN 11.1794 22.5970

WILDCAT DRAG 1.8524

CORRECTED MEAN 13.0318

BOLSTER EFFICIENCY .5767

B31


0 10 20 30 40 50 60
0 10 20 30 40

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject [illegible] POWER EFFICIENCY TEST # 147 Chkd. [illegible] date

Sheet No. of

UP FOUR DRY 34.8 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
55.	29.5	30.2	15.7
54.9	28.	28.6	16.5
51.6	27.	30.5	16.
30.	31.5	29.1	16.6
55.9	30.1	28.5	16.7
54.6	27.2	29.9	14.9
48.4	33.6	28.3	17.8
58.3	33.1	29.4	17.2
58.	26.	30.6	15.7
49.	32.5	28.5	17.5
56.7	31.1	29.6	15.6
55.8	30.1	28.7	16.7
52.2	28.9	29.7	16.3
52.3	31.9	28.9	16.6
55.5	31.	28.2	16.8
36.1	26.5	30.1	15.
51.	31.9	25.7	16.4
Total 915.3	509.9	490.3	278.2
Ave. 53.8411	29.99141	28.8411	16.3641

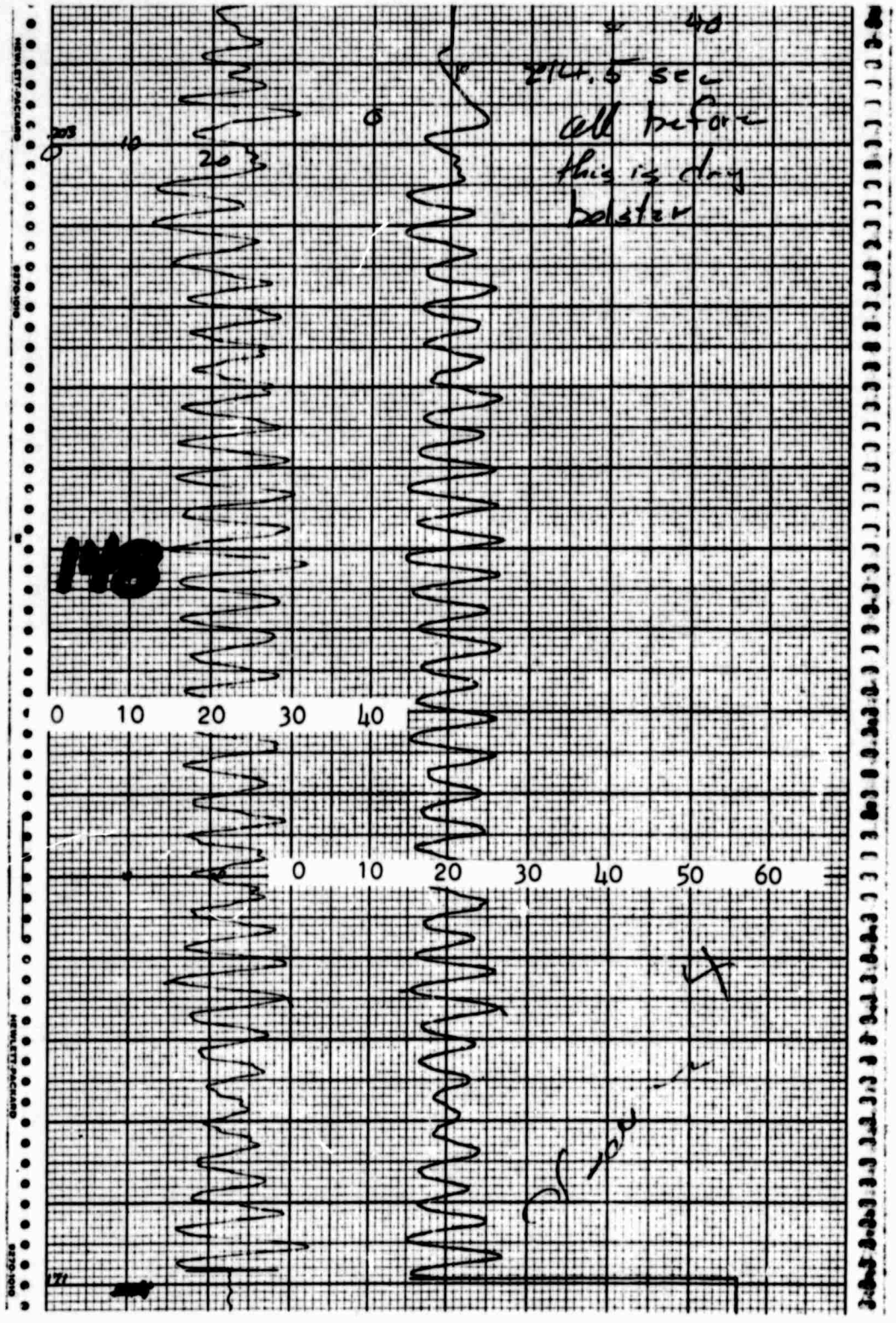
Mean 41.9176 22.6029

Wildcat Dras .1298 5.4409

Corrected Mean 36.4767

Bolster Efficiency 0.6196

B33


0 10 20 30 40
0 10 20 30 40 50 60
Elapsed sec
cell before
this is dry
bolster

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject [illegible] EFFICIENCY TEST # 148 Chkd. JCS date

Sheet No. of

DOWN FOUR, DRY 37.24 FPM

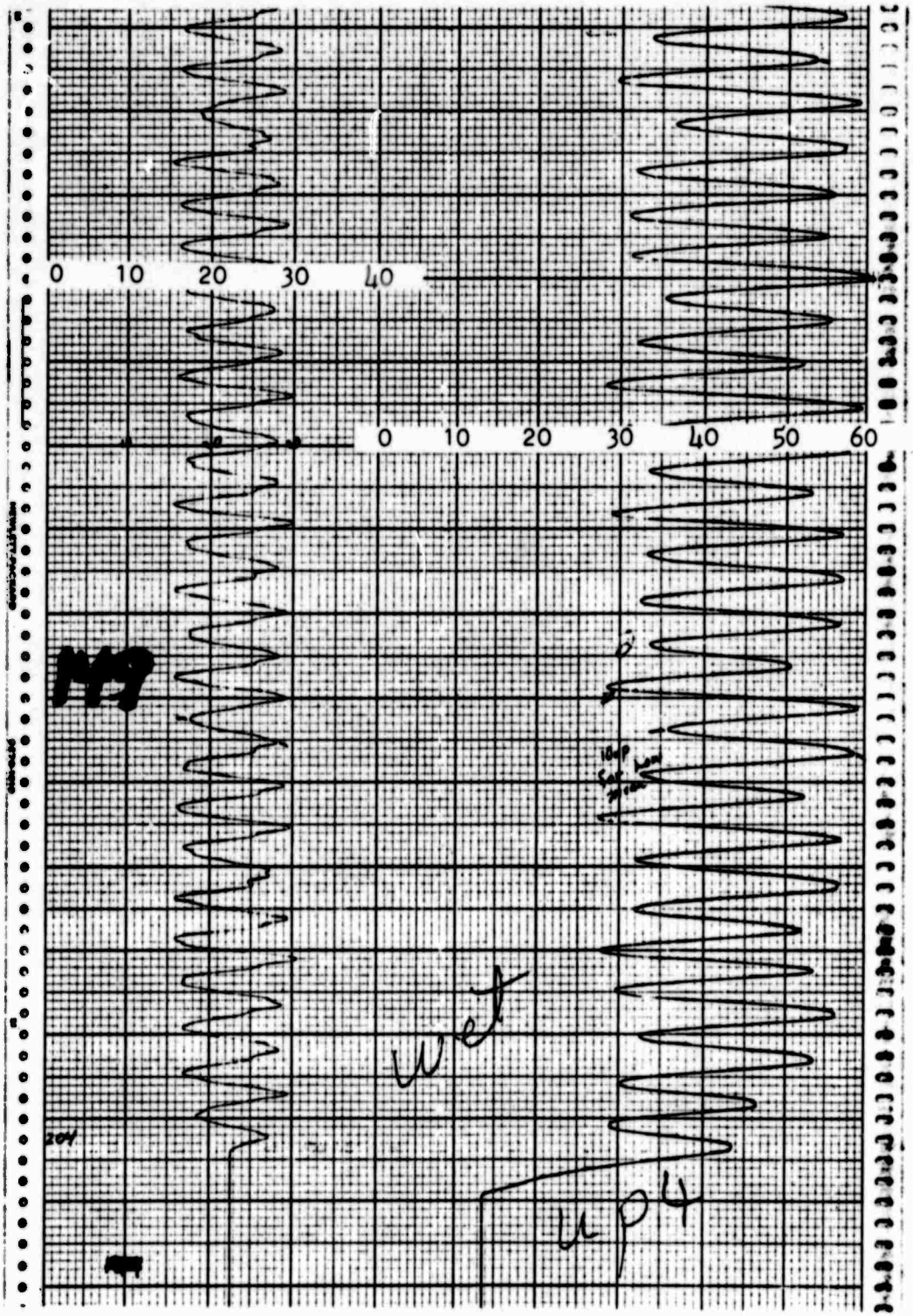
IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
16.4	5.5	29.4	15.7
16.	6.	29.5	16.9
13.4	7.1	28.1	17.7
14.9	7.4	26.8	17.7
13.5	5.9	26.7	17.2
14.6	6.3	29.3	18.
14.1	7.4	26.9	16.7
15.8	5.2	28.2	16.3
15.9	6.1	28.8	16.9
13.6	6.5	28.5	17.5
16.4	6.2	27.7	16.3
15.	5.4	28.4	16.4
16.3	4.5	31.7	15.
16.7	5.9	29.6	16.5
16.2	4.8	30.2	15.9
15.7	6.2	29.5	15.9
14.2	6.7	28.4	16.3
TOTAL 258.7	103.6	487.7	282.9
AVE. 15.2176	6.0941	28.6882	16.6411

MEAN 10.6558 22.6646

WILDCAT DRAG 1.7656

CORRECTED MEAN 12.4214

BOLSTER EFFICIENCY .5481


0 10 20 30 40
0 10 20 30 40 50 60
wet
up4

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject BOLSTER EFFICIENCY TEST # 149 Chkd. JCS date

Sheet No. of

UP FOUR, WET 33.75 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
58.7	35.8	28.1	17.5
59.1	28.4	29.2	15.7
60.5	33.8	28.3	17.4
56.8	32.5	29.3	15.8
57.2	33.3	28.2	17.1
57.2	29.	30.	15.7
53.2	33.6	28.1	17.2
57.8	34.7	28.	17.1
57.6	28.3	30.	16.
52.1	32.1	28.5	17.
55.6	25.3	27.6	17.
61.5	31.3	29.	16.3
55.	31.	29.2	16.4
55.9	31.9	28.1	15.5
57.3	36.6	27.	18.5
59.1	29.5	28.8	16.4
53.6	33.7	29.3	16.8
TOTAL 960.2	550.8	485.7	283.4
AVE. 56.4823	32.4000	28.5705	16.6705

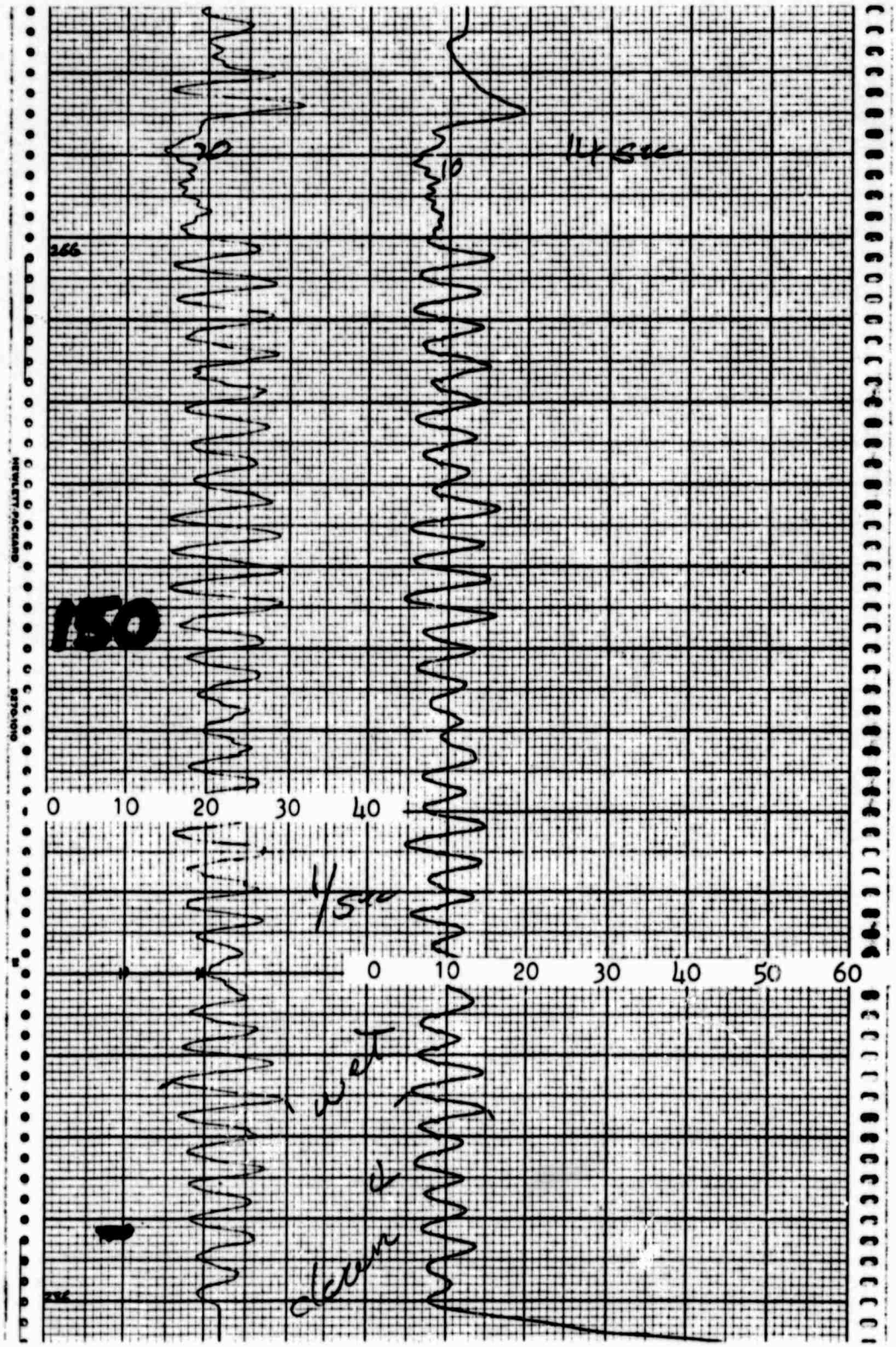
MEAN 44.4415 22.6205

WILDCAT DRAG .1298 5.7684

CORRECTED MEAN 38.673

BOLSTER EFFICIENCY 0.5849

B37


1½ sec
150
0 10 20 30 40
1/5 sec
0 10 20 30 40 50 60

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject Chkd. date

BOLSTER EFFICIENCY TEST # 150 Sheet No. of

DOWN FOUR WET 38.57 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
15.	5.6	29.5	15.9
14.6	6.4	28.1	17.0
11.7	6.6	26.3	18.1
13.4	9.4	25.1	20.3
12.	8.0	24.6	18.8
12.2	5.3	26.8	17.5
13.4	7.5	26.4	17.4
14.3	4.6	27.1	15.6
14.7	6.8	28.7	17.1
12.9	6.7	26.3	17.6
13.6	9.0	25.5	19.6
12.	7.7	25.1	18.8
12.4	6.0	26.3	17.3
13.5	7.7	26.7	16.4
16.	4.4	29.1	15.2
15.3	5.4	29.0	15.3
14.4	5.2	28.8	15.0
TOTAL 230.9	112.3	432.6	292.9
AVE. 13.5823	6.6059	25.4471	17.2294

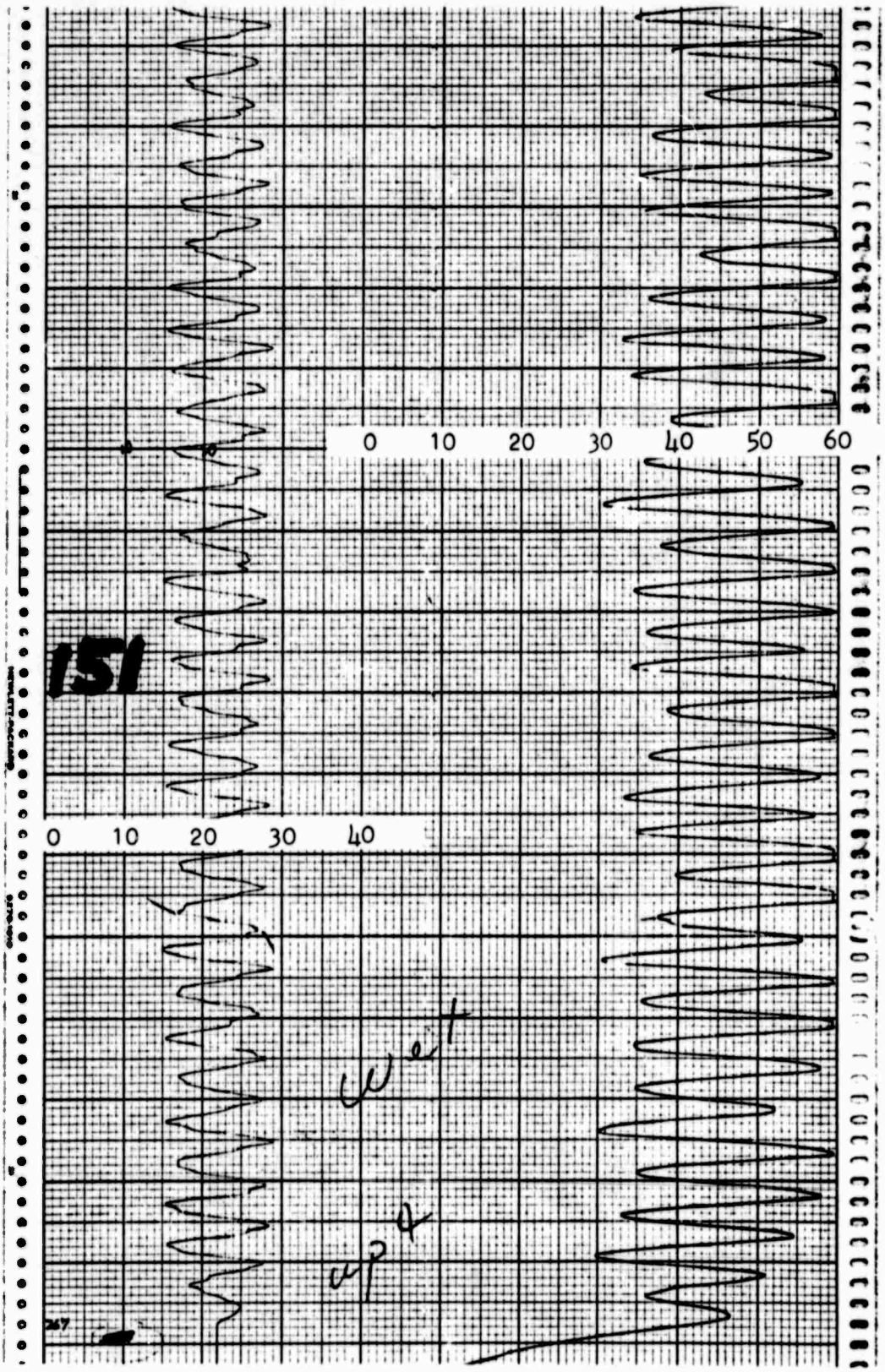
MEAN 10.0941 21.3382

+ WILDCAT DRAG .1657 : 6726

CORRECTED MEAN 1.7667

BOLSTER EFFICIENCY .5514

B39


0 10 20 30 40 50 60
151
0 10 20 30 40
wet
up

CALCULATION WORK SHEET

SHIPBOARD [illegible] ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. [illegible] date _____
Subject _____ Chkd. [illegible] date _____
[illegible] - OFFICIAL TEST # 151 Sheet No. _____ of _____
UP FOUR WET 51.76 FPM

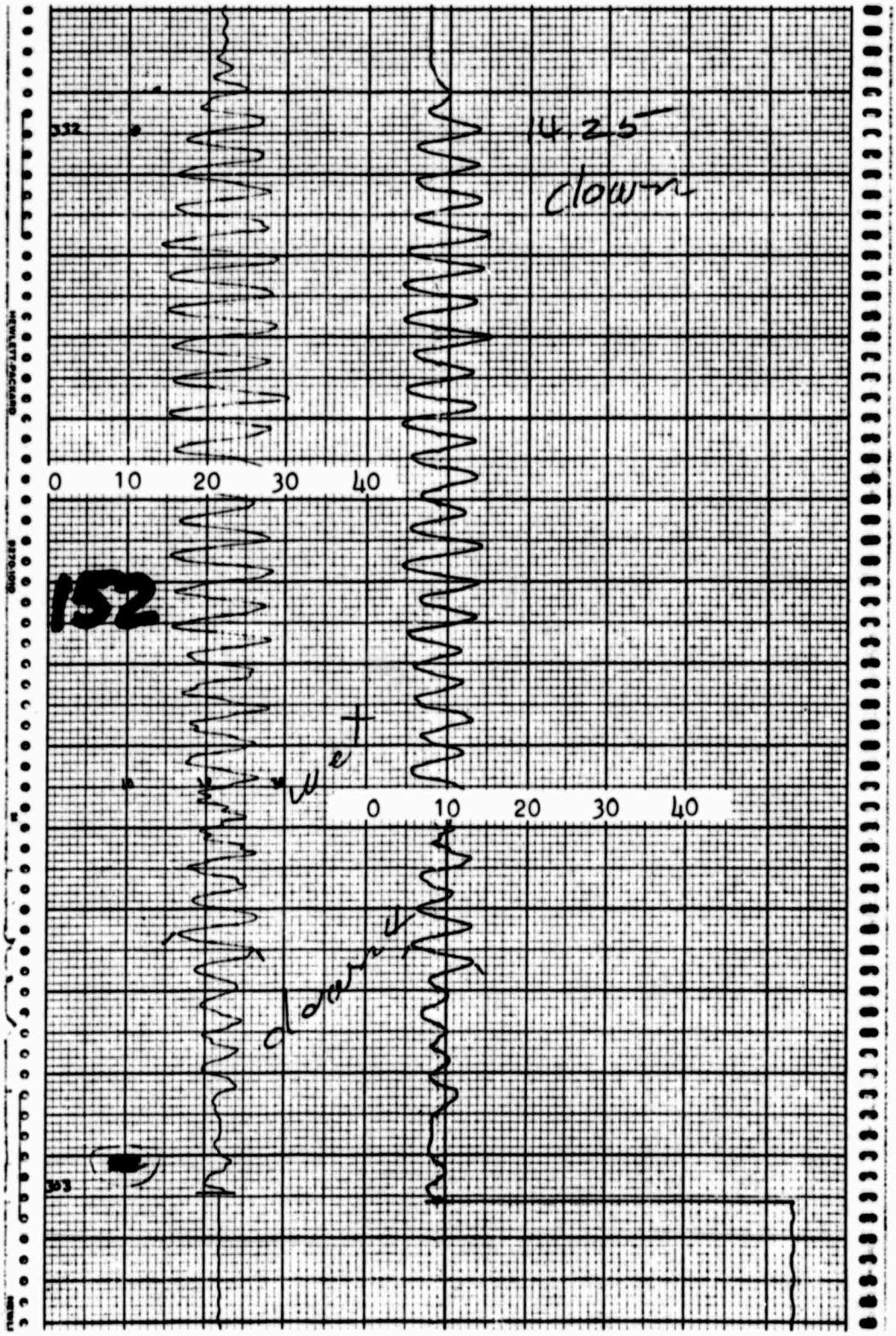
IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
	37.5	27.1	16.9
	37.6	27.4	17.
	34.9	28.1	15.9
	33.3	28.4	15.4
	36.4	26.9	15.6
	38.6	27.	16.9
	34.2	28.5	15.
	36.1	28.1	16.4
	34.4	28.	15.
	37.7	25.9	17.
	30.5	28.	15.2
	35.7	27.1	16.1
	39.	27.8	16.5
	34.1	27.8	16.
	32.9	28.7	15.4
	36.2	27.	15.5
	42.4	26.5	17.5
TOTAL	613.5	468.6	273.3
AVE. 58.65	36.0882	27.5647	16.0764

MEAN 47.3691 21.8205

— WILDCAT DRAG 6.1485

CORRECTED MEAN 41.2205

BOLSTER EFFICIENCY .5294


14.25
clown
0
10
20
30
40
152
0
10
20
30
40
clown

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject "E" SHAFT EFFICIENCY TEST # 152 Chkd. JCS date

Sheet No. of

DOWN FOUR, WET 37.89 FPM

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
13.4	5.7	26.3	16.5
13.2	6.3	26.6	18.3
10.8	6.7	25.2	17.8
13.1	8.2	26.4	19.1
11.	7.3	25.2	18.9
12.3	5.5	26.7	17.4
12.1	6.6	26.3	17.9
13.3	6.	28.	16.9
12.	5.8	26.	17.6
11.8	5.2	28.1	15.7
13.7	6.6	27.6	16.
14.	4.4	28.4	15.5
14.4	5.4	28.	16.6
12.3	6.7	26.1	18.
13.7	5.5	26.9	15.9
13.5	4.3	28.1	15.3
13.4	4.9	30.4	15.8
TOTAL 218.0	101.1	460.3	289.2
AVE. 12.8235	5.947	27.0764	17.0117

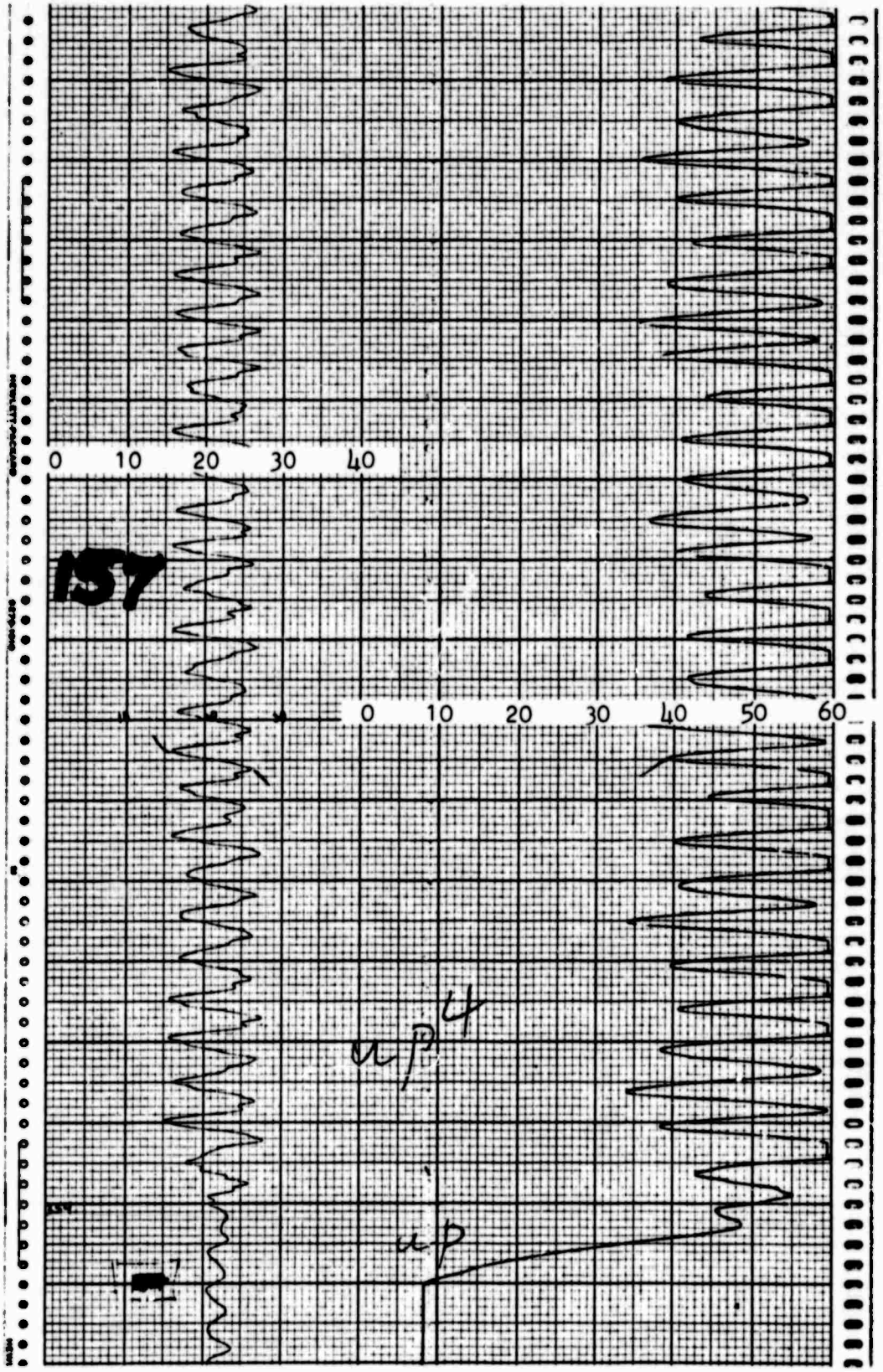
MEAN 9.3852 22.0441

WILDCAT DRAG 1.5551
.1257

CORRECTED MEAN 16.9403

BOLSTER EFFICIENCY .4962

B43


0 10 20 30 40
157
0 10 20 30 40 50 60
up
up

CALCULATION WORK SHEET

NAVSHIPS 0911 ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject BOLSTER EFFICIENCY TEST # 157 Chkd. JCS date
Sheet No. of
UP FOUR WET 27 F.P.M

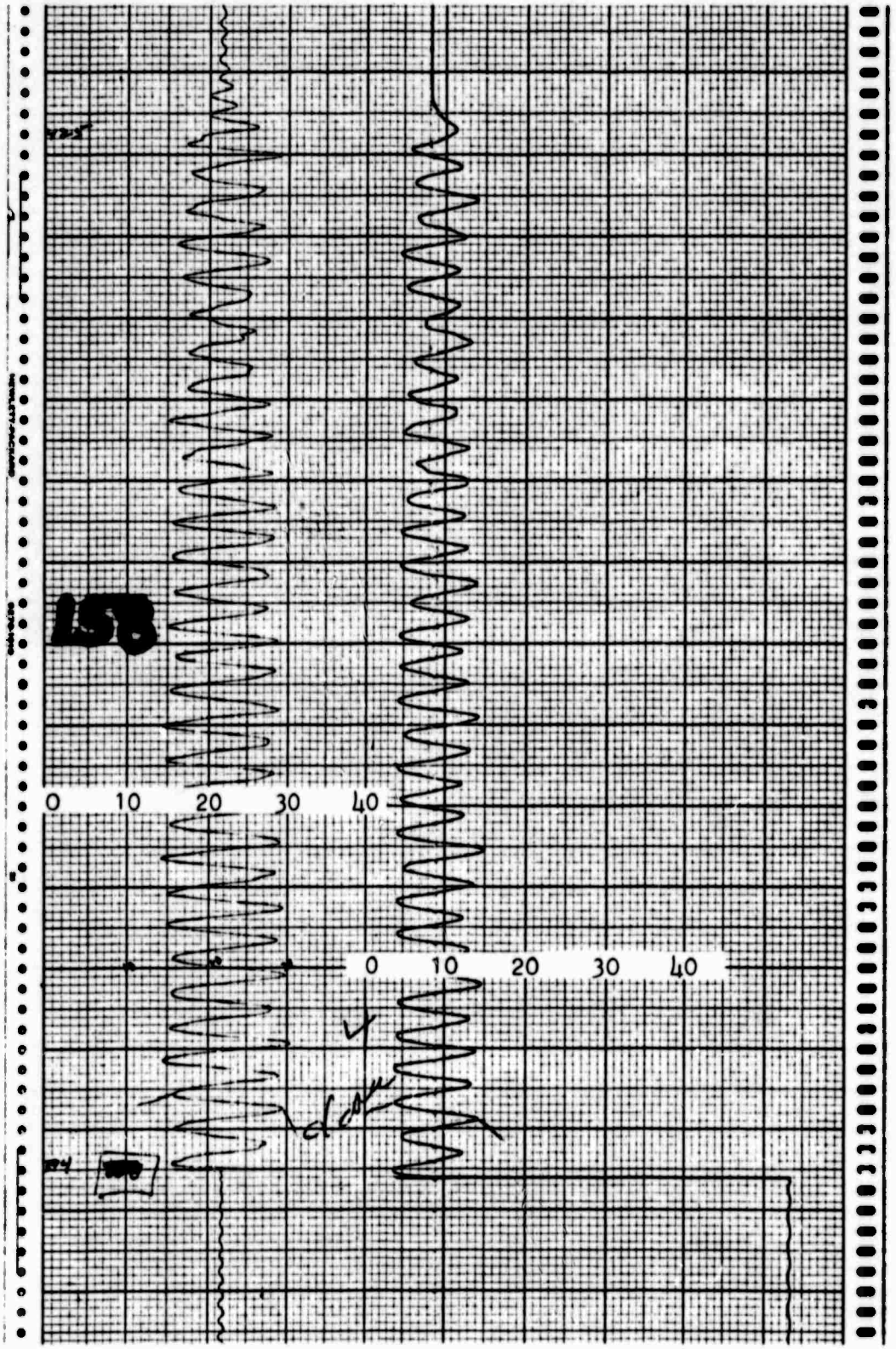
IN LINE TENSIONOMETER.		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
	39.2	26.1	16.
	39.5	26.1	16.6
	41.6	25.4	17.5
	41.	26.8	16.
	44.	26.	17.2
	40.	26.3	15.9
	36.7	25.9	16.3
	41.	25.6	16.3
	40.7	26.6	15.8
	44.	25.3	17.5
	38.	27.	16.4
	35.3	27.	16.3
	38.9	27.	16.
	42.2	27.	16.8
	40.	26.6	16.9
	35.5	26.1	15.8
	40.	25.5	16.9
TOTAL	674.5	446.3	280.2
AVE. 60.3200	39.6765	26.2329	16.4823

MEAN 49.9982 21.3676

WILDCAT DRAG .1295 6.4891

CORRECTED MEAN 43.5091

BOLSTER EFFICIENCY .4911


0
10
20
30
40
0
10
20
30
40

CALCULATION WORK SHEET

SAVEBOARD COAST ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject TOWED EFFICIENCY TEST # 158 Chkd. JCS date
Sheet No. of
DOWN FOUR WET

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
14.3	4.	29.5	15.8
13.4	3.9	29.	14.5
14.	4.3	30.4	15.3
13.2	4.4	28.	15.5
14.6	4.5	29.8	15.6
13.1	4.3	28.7	15.
12.3	4.2	29.4	15.
13.7	5.	28.4	14.3
15.	4.2	29.	15.2
12.3	4.7	27.	16.
12.1	4.4	28.1	15.
13.1	5.1	27.5	14.5
14.2	4.3	28.9	15.3
12.9	4.5	28.4	16.
12.1	4.5	28.6	15.1
13.	5.9	27.5	15.8
14.	4.6	27.6	15.5
TOTAL 227.3	76.8	485.8	259.4
AVE. 13.3706	4.5176	28.5765	15.2588

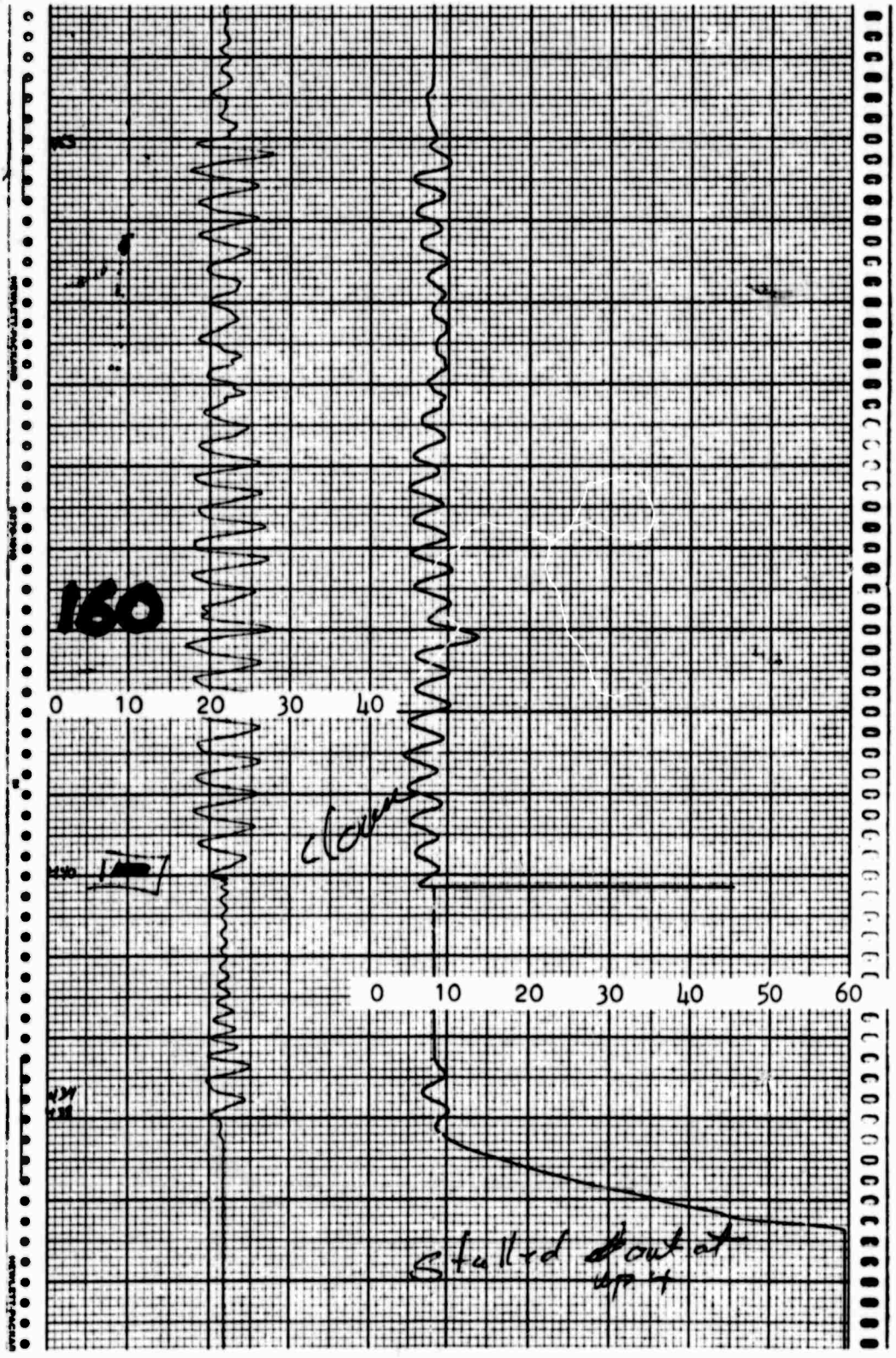
MEAN 8.9441 21.9176

WILDCAT DRAG (.165) 1.4820

CORRECTED MEAN 10.4261

TOLSTER EFFICIENCY .4756

B47


160
0 10 20 30 40
0 10 20 30 40 50 60
Stalled about at

CALCULATION WORK SHEET

SHIPBOARD OCEAN ENGINEERING SYSTEMS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date

Subject BOLSTER EFFICIENCY TEST #160 Chkd. date

Sheet No. of

DOWN WET

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
9.	5.7	24.3	18.6
8.9	5.	25.5	18.
9.3	4.8	25.6	18.2
8.7	4.2	26.	18.4
9.5	4.9	26.	17.8
10.3	5.6	26.3	17.9
10.2	5.8	26.	17.
13.8	7.3	27.4	19.
10.4	5.4	25.5	17.8
10.5	5.1	27.1	18.
10.	5.4	26.8	18.5
9.4	4.9	26.2	18.
8.8	5.4	26.	18.5
9.5	6.4	24.6	19.2
9.7	7.2	24.1	19.6

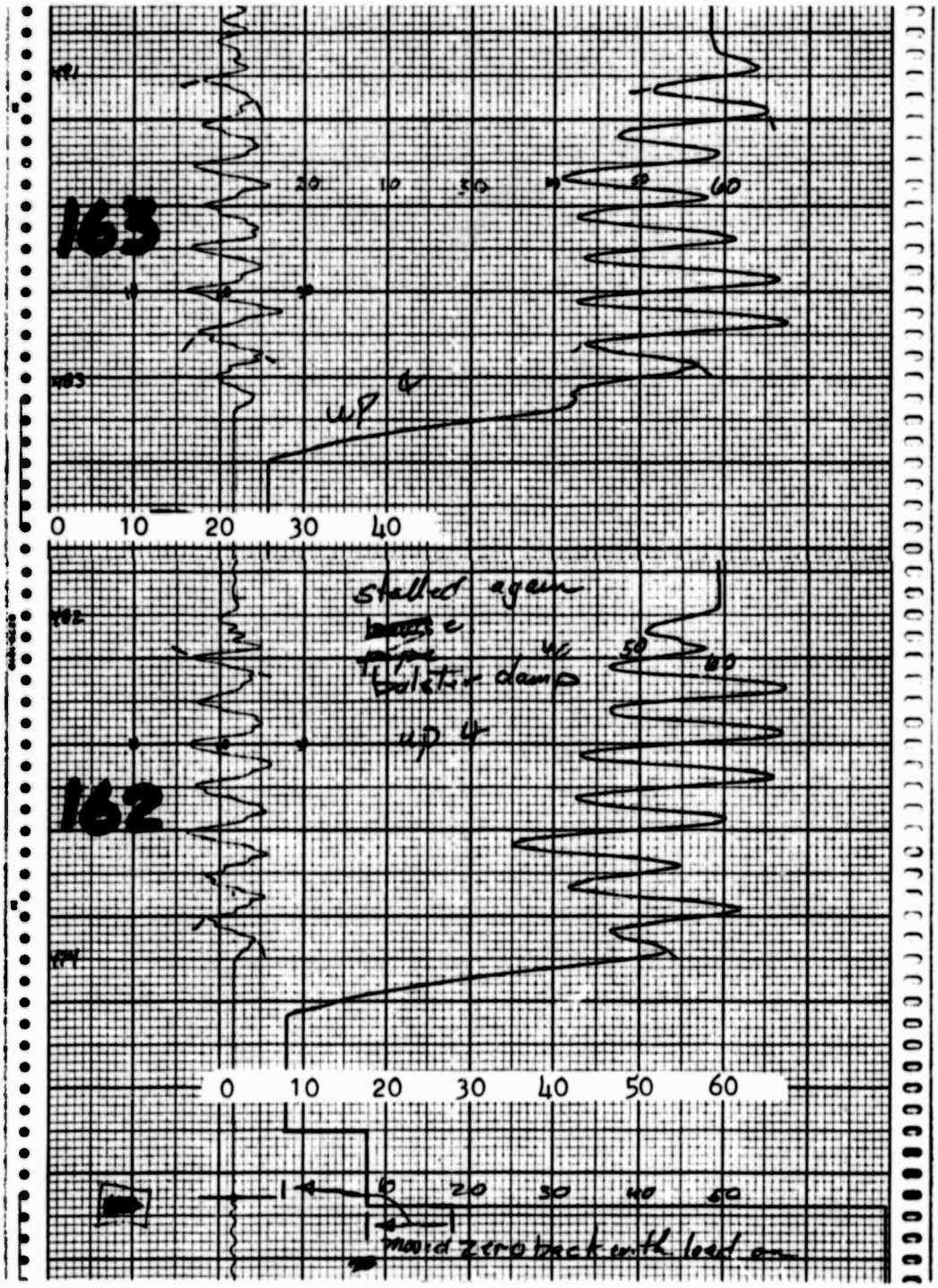
TOTAL	148.0	83.1	387.4	274.5
AVE.	9.8666	5.5400	25.8266	18.3000

MEAN 7.7033 22.0633

WILDCAT DRAG .16573 12766

CORRECTED MEAN 8.9799

BOLSTER EFFICIENCY .4010


163
0 10 20 30 40
up
162
stalled again
up
0 10 20 30 40 50 60
moved zero back with lead on

CALCULATION WORK SHEET

SALVAGE DIVING & PILEDRIVING SUBSYS SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. [illegible] date

Subject "TOWED FERRICRAFT TEST" 1-82 Chkd. [illegible] date

Sheet No. of

UP FOUR DAMP - STALL

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
53.2	46.7	24.4	18.7
62.	41.8	25.6	18.4
54.8	[illegible]	25.8	16.2
60.2	42.5	25.7	17.1
64.	43.1	26.3	16.6
57.	46.6	25.1	17.4
67.5	46.5	24.	16.9

TOTAL	430.7	302.2	176.9	121.3
AVG.	61.5286	43.1714	25.2714	17.3285

MEAN 52.3500 21.2999

WILDCAT DRAG .1298 6.7950

CORRECTED MEAN 45.5549

BOLSTER EFFICIENCY .4675

CALCULATION WORK SHEET

SALVAGE [illegible] SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject Chkd. JCS date
"[illegible] TEST" 163 Sheet No. of
UP FOUR DAMP - STALL

IN LINE TENSIONOMETER.		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
57.	43.7	25.1	17.5
67.7	42.7	27.5	16.1
66.8	43.5	25.1	16.8
61.4	42.7	24.7	18.
58.	40.9	26.	17.
59.3	47.4	24.6	17.9
65.2	51.4	24.	18.

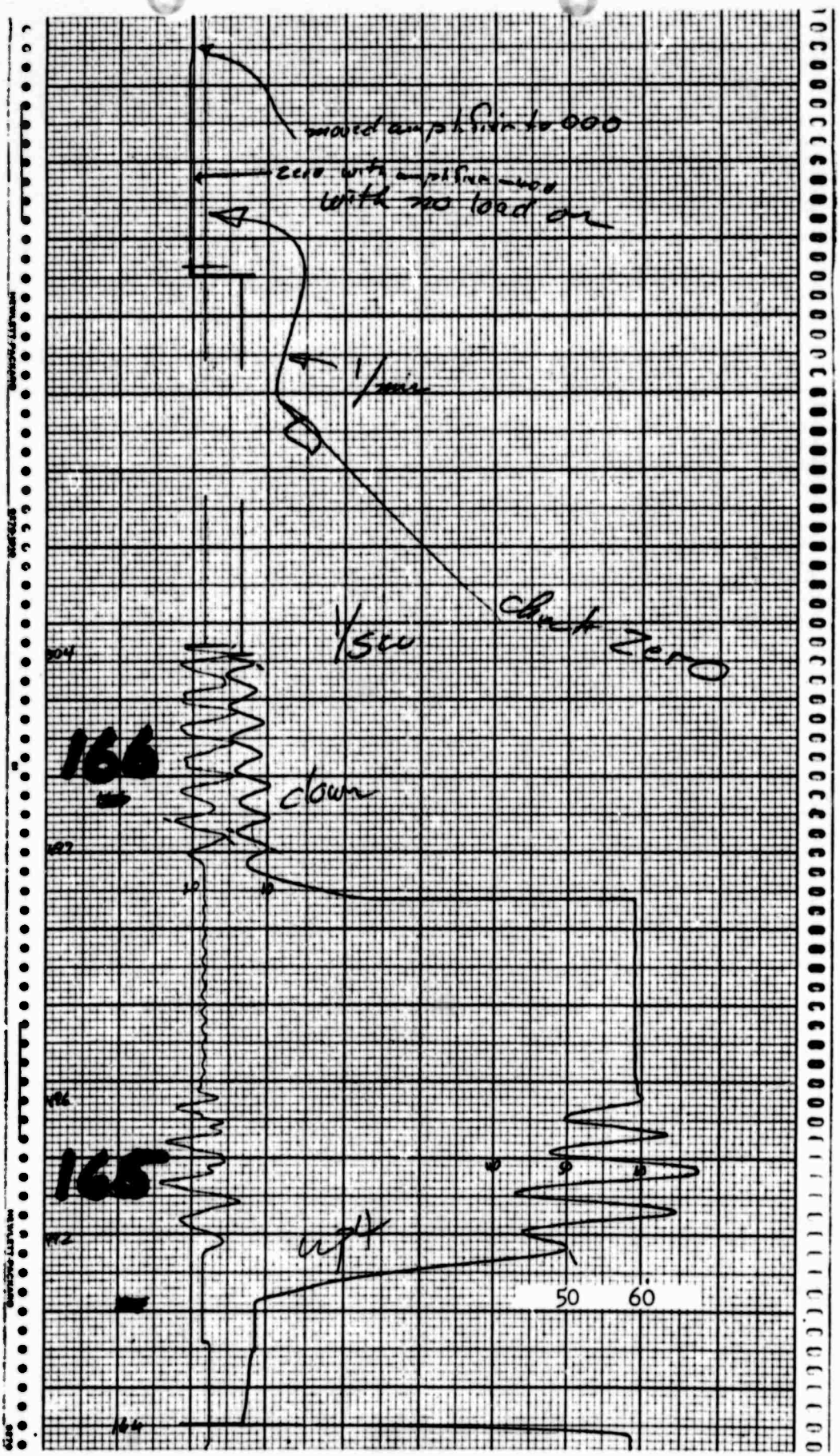
TOTAL	435.4	312.3	177.0	121.3
AVE.	62.2	44.6143	25.285 7	17.3285

MEAN 53.4071 21.3071

WILDCAT DRAG .1298 6.9322

CORRECTED MEAN 46.4748

BOLSTER EFFICIENCY .4584


moved amplifier to 000
zero with amplifier
with no load on
1/min
1/sec
check zero
clown
50
60

CALCULATION WORK SHEET

SUBJECT TO THE PROVISIONS STATED IN SECTION 6162E

U.S.S. ORTOLAN ASR-22 Calc. JAMIE date
Subject Chkd. JC date
RATED EFFICIENCY TEST # 166 Sheet No. of
DOWN DIVE

IN LINE TENSIONOMETER		TEST LOAD TENSIONOMETER	
HIGH	LOW	HIGH	LOW
10.1	6.	24.5	17.5
10.2	6.3	23.	18.3
10.2	5.7	25.5	18.9
9.3	5.	25.5	18.3
9.5	4.9	26.	18.5
8.6	4.5	25.4	18.3
8.1	4.9	25.4	18.9

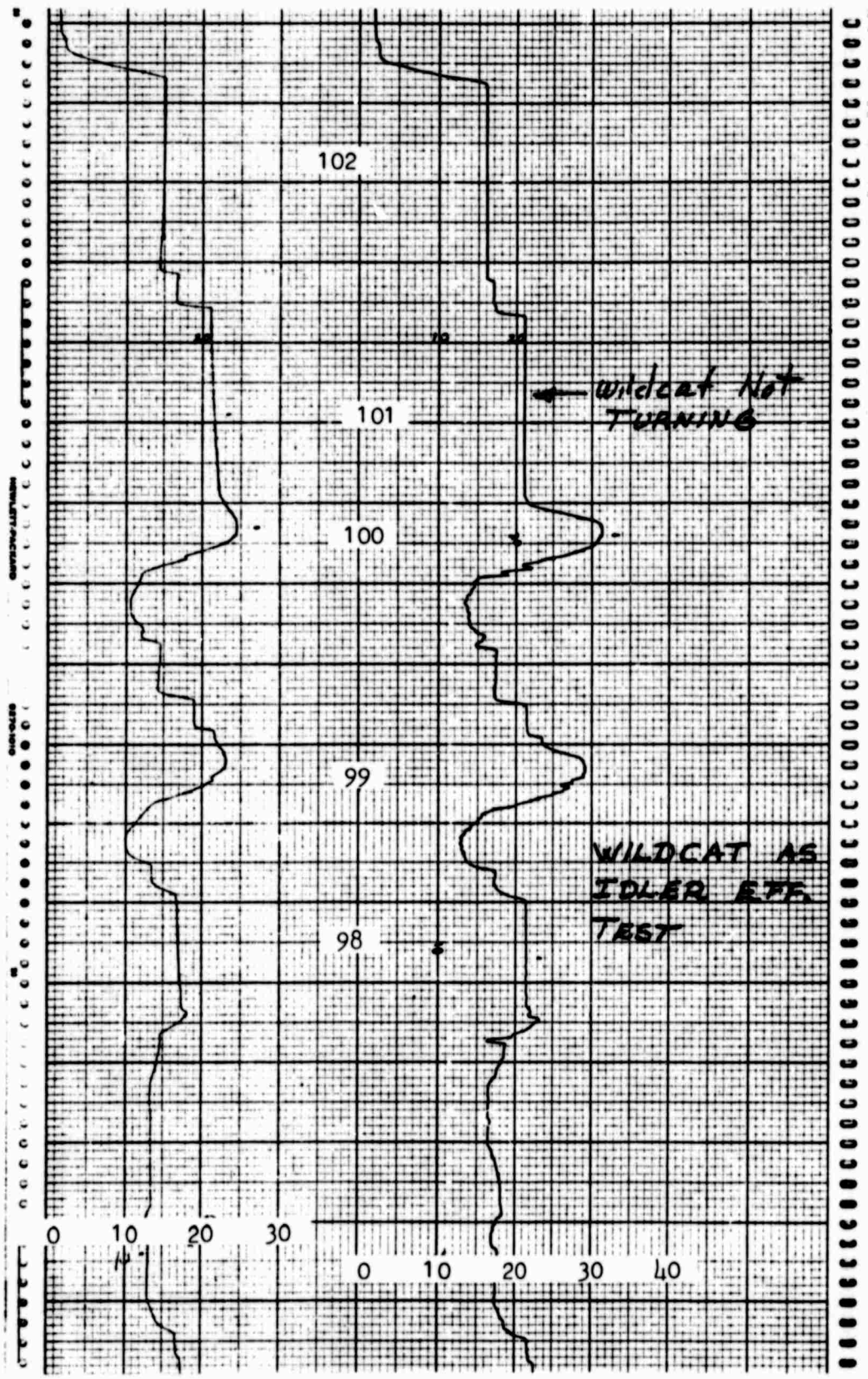
TOTAL	66.0	37.3	175.3	128.8
AVE.	9.4285	5.3285	25.0428	18.4000

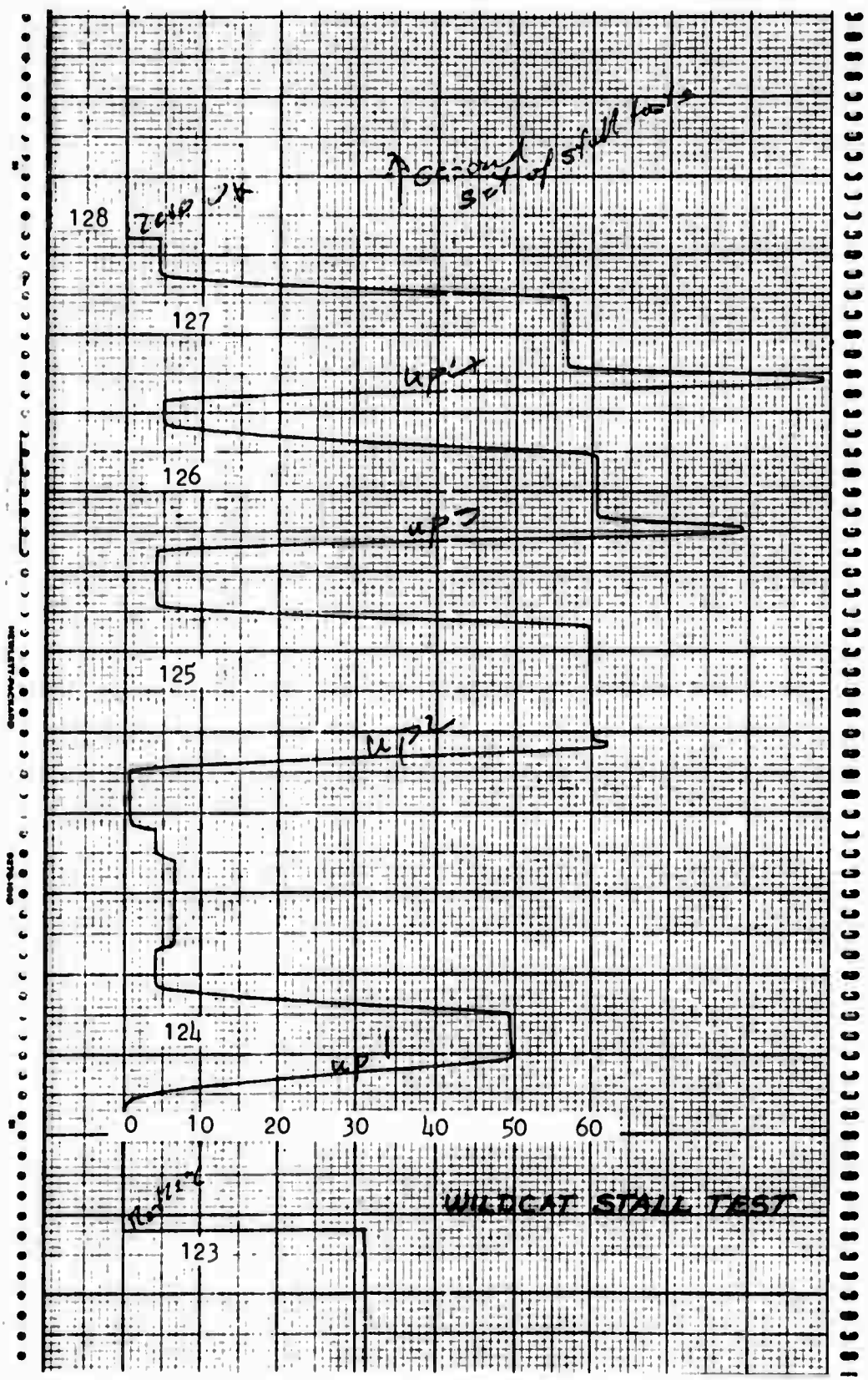
MEAN 7.3785 21.7214

WILDCAT DRAG 1.2226

CORRECTED MEAN 8.60111

TOLSTER EFFICIENCY .3959


102
101
100
99
98
Wildcat Not Turning
WILDCAT AS IDLER EFF. TEST
0 10 20 30
0 10 20 30 40


128
127
126
125
124
123
0
10
20
30
40
50
60
WILDCAT STALL TEST

APPENDIX C

ANCHOR WINDLASS TEST DATA AND CALCULATIONS

PORT ANCHOR WINDLASS
ASR 22 windlass test at PNSY
while in drydock

TIME	PUMP DISCH.	PUMP SUCT.	TEMP °C	REPLN
1330	1000	300	27	322
1338	3500	300	28	320
1341	1150	280	28	315
1355	1000	300	34	310
1358	3550	300	34	310
1400	3700	290	34	280
1406	1650	300	36	325
1408	3600	300	37	290
1409	1700	298	37	325
1415	1070	270	38	288
1418	3600	305	38	290
1419	3800	280	39	270
1420	1550	280	39	355
1421	3600	270	39	290
1438	3500	280	41	290
1439	3650	300	42	310
1445	3600	290	42	290
1447	1000	300	42	290
1450	SECURED		42	
1511				
1513	3300	250	44	280
1515	3500	250	44	270
1516	1500	250	44	290
1518	3500	200	44	270
1520	1300	250	44	330
1521	1300	300	45	345
1526	1300	300	46	305
1530	SECURED		46	

PORT FWD WINDLASS

1256	2500	295	28	300
1308	700	300	27.5	360
1315	1350	290	28	330

TIME	PUMP DISCH.	PUMP SUCT.	TEMP °C	REPLIN
1326	975	700	29.5	340
1350	1850	280	29	330
1357	3500	260	30	320
1403	1000	350	32.5	310
1407	3500	250	33	320
		STALL TESTS		
1435	3600	250	32	310
1447	3650	250	33.5	310
1450	3650	250	34.5	300
1503	1200	275	35	310
1510	950	300	36	300
1517	950	300	36	300
1527	950	300	37	300
1600	1000	290	38	300
1602	1100	300	39	340
1603	1300	290	39	300
1610	1200	300	39	350
1611	1500	300	39	300
1615	1000	300	41	700
1617	2000	310	41	310
1618	1000	220	42	300
1619	1200	250	42	300
1630	1200	300	40	290
1640	700	300	42	290
1645	1200	225	41	300
1655	1500	300	44	300
1660	1000	225	45	285
1705	1500	290	45	290
1715	1000	300	45	290

CALCULATION OF HORSEPOWER REQUIREMENTS

1. Hydraulic Motor Horsepower (HP_H) = $\frac{\text{Load on Wildcat } (L_w) \times \text{Wildcat Velocity}}{33000 \times .85 \text{ (Gearbox eff)}} = \frac{L_w \times 24}{33000 \times .85} = .00085\ L_w$

2. Electric Motor Horsepower (HP_E) = $\frac{HP_H}{\text{Hydraulic Transmission Eff}} = \frac{HP_H}{.75}$

Load on Wilcat L_w	Hydraulic Mot. HP_H	Electric Mot. HP_E
45,000	38.5	51.4
50,000	42.7	57.0
60,000	51.4	68.5
70,000	60.0	80.0
80,000	68.4	91.0
90,000	77.0	102.5
100,000	85.5	114.0

CALCULATION OF WILDCAT LOADS

$$\text{Load on Wildcat } (L_w) = \frac{\text{Load outside bolster}}{\text{Bolster Eff}}$$

Load Before Bolster	Efficiency of Bolster				
	65%	60%	55%	50%	45%
25,000	38,200	41,600	45,500	50,000	55,500
30,000	46,200	50,000	54,600	60,000	67,000
35,000	53,900	58,400	63,600	70,000	78,000
40,000	61,160	66,600	72,700	80,000	89,000
45,000	69,400	75,000	82,000	90,000	100,000
50,000	77,000	83,500	91,000	100,000	111,000
55,000	84,600	91,800	100,000	110,000	122,000
60,000	92,000	100,000	109,000	120,000	133,000

PIGEON (ASR 21) TEST CONDUCTED ON 17 OCT 1974

PORT ANCHOR WINDLESS TEST

TIME (Mins)	PUMP PSIG	AMPS	MOTOR SUMP (Temp)
03	285/250	28	120
05	310/300	27	120
10	325/450	26	118
15	325/600	26	118
20	225/350	26	124
25	320/800	29	125
30	315/950	28	128
35	310/900	32	131
40	310/1050	[illegible]	[illegible]
45	270/250	26	135
50	250/2000	39(1)	135
55	240/2100	71(2)	136
60	230/2400	66(3)	139
65	230/2200	76	142
70	230/2100	68	145
75	235/1800	60	150
80	230/1600	54	---
85	235/1250	46	156
90	235/950	38	157
95	245/750	30	159

NOTE: (1) Surge to 74
(2) Surge to 80
(3) Surge to 83

7 October 1974
San Diego, Calif.

USS PIGEON (ASR-21)

[illegible] ANCHOR WINDLASS TEST

TIME	PSIG PUMP	DISCH °F	[illegible] IP K	CASING °F	MOTOR AMPS	REPLEN PSIG	REMARKS	STRAIN from 0
1800	250/125	80		80	24	325	Idle	
1815	250/125	83		86	24	320	Idle	
1820	250/125	86		88	27	280	Start Out	+2
1825	175/200	87	/*92	86	25	330	"	+3
1830	190/380	90	/92	86	24	355	"	+4
1835	180/750	98	/97	86	24	350	"	+4-5
1840	187/850	97	/104	88	26	340	"	+4-5
1845	[illegible]	98	/107	88	24	260	Stop	+5 +10
1850	125/190	96	/110	88	24	275	Idle	+5
1855	125/185	98	/110	89	24	275	Idle	+5
1900	125/187	98	/112	90	38	280	In Haul	+5
1905	125/187	99	/112	90	24	280	Idle	+5
1907	100/2000	101	0/113	90	65	260	Inhaul	+5
1910	100/1800	105	o/113	91	60	260	"	+5
1915	100/1700	107	4/116	94	56	255	"	+6
1920	187/1600	106	5/123	99	44	270	"	+5
1925	125/1500	106	5/124	95	30	270	"	+6
1930	125/1500	108	7/125	95	32	255	"	+7
1935	197/1300	113	9/127	96	44	250	"	+7
1940	187/1000	114	1/130	97	35	250	Motor RPM Oscil. with ca link, Idle	±7-8

7 October 1974
San Diego, Calif.

TIME	PUMP PSIG	°DISCH F	SUMP TANK °F	CASING MOTOR °F	AMPS	REPLEN PSIG	REMARKS	STRAIN from 0
1945	125/250 ***	111	112/134	97	24	255	Idle	+8
1950	125/175 at housing	111	113/134	97	24	280	"	+6
1954	125/1500	112	114/135	97	26	265	Housing	+8

* Immersion thermometer installed in sump tank

[illegible] to 1000

USS PIGEON (ASR-21)

8 October 1974
San Diego, Calif.

PORT ANCHOR WINDLASS TEST

TIME	PUMP PSIG	°F	SUMP °F	MOTOR °F	REPL PSIG	MOTOR AMPS	
1045	125/150	126	120(148)	98	275	24	Lower (Power)
1050	125/375	128	122(148)	98	295	24	Lower (Power)
1055	125/375	128	123(148)	99	295	24	" "
1100	125/650	128	124(149)	94	295	25	" "
1105	125/850	132	125(150)	93	285	24	" "
1110	125/900	129	127(154)	94	282	29	" "
1115	87/150	129	127(154)	96	250	24	Idle (Anchored)
1120	87/150	125	126(154)	97	250	24	" "
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	" "
1130	87/150	124	126(154)	98	250	24	" "
1135	87/2200	128	126(154)	98	235	32	Raise
1140	87/150	127	125(154)	98	245	24	Idle
1145	70/2000	125	124(154)	99	225	68	Raise
1150	70/2000	128	128(160)	100	220	65	"
1155	67/1700	128	130(162)	103	220	65	"
1200	67/1700	125	130(162)	105	225	45	"
1205	70/1500	129	131(162)	105	225	51	"
1210	70/1300	132	132(166)	106	225	42	"
1215	70/950	134	134(166)	117	230	35	"
1220	70/700	130	134(167)	116	240	24	"
1225	70/170	130	134(167)	116	250	24	Idle

[illegible] 4103

8 October 1974
San Diego, Calif.

USS PIGEON (ASR-21)

PORT ANCHOR WINDLASS TEST

TIME	PUMP PSIG	°F	SUMP °F	MOTOR °F	REPL PSIG	MOTOR AMPS	
1230	125/125	130	133(164)	115	250	24	Idle
1235	125/125	130	133(164)	115	250	24	"
1240							
1245							
1250							
1255							

USS PIGEON ASR-21

8 October 1974
San Diego, Calif.

TIME	PUMP PSIG	°F	SUMP TANK °F	MOTOR °F	REPLEN. PRESS PSIG		MOTOR AMPS
0710	0	92	88	86	0	Free Fall	
0840	125/250	85	85	83	305	Idle	24
0850	80/1000	82	89(98)	88	275	Raise	38
0855	80/1000	95	92(102)	87	270	"	38
0900	80/1000	98	95(105)	88	270	"	38
0905	100/950	99	97(109)	90	265	"	38
0910	100/950	103	100(111)	91	260	"	38
0915	100/950	104	102(116)	92	260	"	37
0920	100/900	105	104(120)	93	255	"	36
0925	100/900	106	105(124)	94	255	"	36
0930	100/900	110	107(126)	95	255	"	35
0935	100/900	110	110(126)	95	250	"	35
0940	100/850	110	112(130)	96	250	"	35
0945	100/850	112	113(134)	97	250	"	35
0950	100/850	113	114(137)	97	245	"	35
0955	100/900	115	116(145)	97	245	"	36
1000	100/700	117	117(142)	98	245	"	36
1005	100/1050	118	119(145)	98	240	"	38
1010	100/800	118	119(148)	99	240	"	32
1015	100/250	119	120(148)	99	250	Idle	24
1020	100/250	118	120(148)	99	255	"	24
1025	100/267	117	120(148)	98	255	Idle	24
1030	100/600	116	120(148)	98	260	Raise	32
1035	125/187	117	121(148)	98	260	Idle	24